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Risk Perception and WTP in Connection to Radioactive Substances in Food Products

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Malin Lokrantz

Abstract

Nuclear power accidents can have severe impact on land, animals and people. The perception of risk connected to nuclear power has been a topic for research for decades. Sweden was heavily effected by the nuclear accident at Chernobyl nuclear power plant. Approximately five percent of the radionuclides that spread ended up on Swedish ground. Reindeer meet was one of the most effected food products in Sweden and large amounts had to be discarded. The purpose of this research was to look at risk perception of radioactive substances in food products and find key determinants and find the willingness to pay for potatoes and minced beef and what key determinants could be found for that. A survey was conducted with 218 respondents. The data was analysed using ordered probit model for the level of concern and ordinary least square for willingness to pay for potatoes and minced beef. Main findings were that concern was determined by age, having children, income, knowing a current policy decision, searching for food information connected to Fukushima and two interaction terms where gender interacted with using food recommendation and gender interacted with attitude towards nuclear power. Willingness to pay for potatoes were determined by age, gender, size of household and knowing the current nuclear power production in Sweden. Willingness to pay for beef were determined by age, income, attitude towards nuclear power, searching for origin on food products and knowing the current nuclear power production. The result show that, among the sample, there is a willingness to pay to avoid the risk of radioactive substances in food and that at least some, perceive a risk with radioactive substances in food. However, to be able to draw general conclusions to the population further research must be done focusing on a representative sample and the possibility of extending the questionnaire to be able to better capture the perception of risk and willingness to pay.

Sammanfattning

Ungefär fem procent av de radioaktiva ämnen som spreds efter kärnkraftsolyckan i Tjernobyl år 1986 landade i Sverige. En av de mest kontaminerade livsmedelsprodukterna i Sverige var renkött vilket ledde till att stora mängder renkött kasserades. Riskuppfattning i samband med kärnkraft har varit ett hett ämne i den vetenskapliga litteraturen och betalningsvilja är en erkänd metod för att beräkna monetära värden på varor eller tjänster som inte naturligt finns på en marknad. Riksuppfattning för radioaktiva ämnen i mat i Sverige och betalningsvilja för att undvika en sådan risk är dock inte studerat. Studien tittar på riskuppfattning och betalningsvilja i samband med radioaktiva ämnen i livsmedel och kartlägger de avgörande faktorerna för riskuppfattning såväl som betalningsvilja för en märkning av potatis och köttfärs. Studien bygger på en enkät med 218 deltagare, vilka tillfrågades på väg in i två olika matvarubutiker. För att analysera svaren användes två metoder, ordered probit model och ordinary least square. Riskuppfattning förklaras av ålder, inkomst, kunskap om ett aktuellt kärnkraftsbeslut, sökning av livsmedelsinformation i samband med Fukushima och två interaktionstermer där könstillhörighet interagerar med livsmedelsrekommendationer och kärnkraftsattityd. Betalningsvilja för en märkning av potatis förklaras av ålder, könstillhörighet, hushållets storlek och kunskap om energiförsörjningsgrad från kärnkraft. Betalningsvilja för köttfärs förklaras bland annat av ålder, inkomst och kärnkraftsattityd. Denna studie visar att det kan finnas betalningsvilja för att undvika risker med radioaktiva ämnen i mat. Men för att kunna dra några generella slutsatser om riksuppfattning och betalningsvilja i Sverige behöver en större studie genomföras med fokus på ett representativt urval och med möjligheten att utöka enkäten för att bättre fånga de faktorer som interagerar med riskuppfattning och betalningsvilja.

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Chapter 1 – Introduction

Sweden has a long history of nuclear power. After the Second World War a specialized company owned by the Swedish government aimed to develop commercial production of nuclear power was founded. The first research reactor started in 1954 and the first commercial reactor was in use in the beginning of the sixties (Swedish Radiation Safety Authority, 2014). After atmospheric nuclear bomb tests in the fifties it became clear that food contamination due to radioactive fallouts might be a problematic consequence of nuclear usage (Moberg, 2001). However the radioactive fallouts from a nuclear bomb is not comparable to the fallouts from a nuclear power accident (Yaakov et al. 2009). In the beginning of the seventies the discussion about nuclear power started to become more active and the Swedish political party Centerpartiet clearly stated to be against nuclear power. In 1980 the government decided that nuclear power should be phased out before 2010 as a result of a referendum. However in 2010, it was decided that new reactors was allowed to replace old ones (Swedish Radiation Safety Authority, 2014).

Sweden has one of the largest energy consumptions per capita in the world. Nuclear power works as a baseline of electricity today, an energy source that is stabile and not depending on weather conditions. The present production of nuclear power in Sweden is about 40 percent of the electricity demanded, and hydropower stands for almost the same amount. Power companies in Sweden plans to close four out of ten running reactors earlier than initially planned in 2022, now it will be in 2020. A commission is working on a plan for energy supply beyond the year of 2025. It has been argued which energy source that could take its place if all nuclear power is to be phased out. In such a scenario, a fossil fuel back up system would be needed since hydropower would not manage to tackle the fluctuations if wind power were to cover the loss in energy supply from nuclear power (Wagner & Rachlev, 2016).

The use of nuclear power in Europe is far from equal everywhere. From Italy and Lithuania with no nuclear power to other countries, like France and Hungary, that has larger shares. In total, within the European Union, 132 nuclear power plants produce 27 percent of the electricity (Horvath & Rachlev, 2016). In the ongoing discussion on how to tackle climate change and a growing demand for electricity, nuclear power has been up for discussion in

governments around the world with the benefits of low emission of carbon dioxide in production. This has lead to new policies reversing phase out plans as well as extended use of existing reactors and plans to build new ones. However the accident at Fukushima gave reason to reexamine safety in nuclear production (Moniz, 2011).

In 2016, it's been 30 years since the nuclear accident in Chernobyl, Ukraine, and five years since the nuclear accident in Fukushima, Japan. They were both graded with the highest grade on the international seven-point scale, INES-scale, corresponding to a big accident (Swedish radiation safety authority, 2016). The consequences of a nuclear accident could be acute from lethal doses of radiation or more long-term effects such as increased risk of cancer, populations that needs do be moved to avoid exposure to radioactive substances and contamination of agricultural land. Considering the effects on human health, especially deaths, a potential nuclear accident in the size of Fukushima or Chernobyl, would be responsible for estimated 10,000 cases of fatal cancers (Rabl & Rabl, 2013).

Each severe accident seems to influence the attitude against nuclear power (Drottz-Sjöberg & Sjöberg, 1990; Ivanova 2014). Qvist and Brook (2015) argues that given the track record for nuclear power regarding safety in Sweden it is an unreasonable high aversion towards nuclear power in political parties as well as the larger masses. Especially in comparison with other industrial activities making the authors draw the conclusion that it has to some extent be a case of misinformation. Comparing fatalities from energy production accidents, nuclear power seems to be less harmful than other sources. Havenaar et al. (2003) points out that one effect from the Chernobyl accident was an increase in thyroid cancer in children, which was one of few significant physical effects. Nesterenko et al. (2009) argues that the need for strong correlation in medical research in this matter should be questioned. Since it took several days before testing of the radioactive levels begun, initial levels are unknown and the true levels the first few days could well exceed the levels measured weeks and even months after. Therefore it makes it hard to find strong correlation. Psychological, however, Havenhaar et al. (2003) found an increase in stress-related health issues in several of the affected areas in Belarus, Ukraine and Russia.

Nuclides spread from a nuclear power accident can be dangerous directly, as well as the accumulation in the eco-system. This is of great concern in the food chain (Mascanzoni, 1987). Even before the accident in Chernobyl, radionuclides could be found in food

products, due to fallout from nuclear testing from the fifties. However the amount that the population of Sweden receive due to food intake is too small to give any significant increase in cancer incidences (Moberg, 2001). However there is still reason to be concerned, long-term effects can be hard to know and predict in advance. As Grande (1999) concludes, experts and citizens might not calculate risk likewise.

There might not in general be any significant increase in cancer incidences but the psychological effects might still be present. Human behaviour can be explained by knowledge and risk perception, which influences the choices we make. Even though experts assures something to be safe this might not automatically lead to the public feeling assured. Rosati and Saba (2004) mean that public perception is not always driven by technical risk; rather it is a set of different psychologically determined characteristics. This is of great concern in policy making since it makes it harder to reach out to the public to make trustworthy policies. Drottz-Sjöberg and Sjöberg (1990) argue that people perceive a higher risk when the risk is consider unjust, less known, beyond their control or forced upon them. They even mention a study where no relation could be found between experts' and the publics' perceived risk of the same issue.

Rabl and Rabl (2013) estimate losses of agricultural land from a potential nuclear accident to be 1000 km^2 for the following 100 years. The effect on food production could therefore be huge. In the aftermath of Chernobyl large parts of Europe were affected. In Sweden was reindeer meet highly effected, where large shares had to be discarded (Mascanzoni, 1987; Bostedt, 2001) and in Norway large amounts of goat milk was discarded for human consumption (Tveten et al. 1998).

1.1. Motivation and problem statement

To solve the problems with climate change we need to reduce carbon dioxide emissions. Demand for electricity is also likely to increase (Horvath & Rachlew, 2016). Several nuclear reactors in Sweden is planned to shut down and a commission is working on a plan for energy supply beyond 2025 (Wagner & Rachlew, 2016). Germany is planning to phase-out nuclear power until 2022. At the same time others, such as Finland and France, is planning to expand nuclear power with the new fourth generation that could be introduced commercially around the same time (Horvath & Rachlev, 2016). The future for nuclear power seems to depend on who is making the decision. There is high reluctance to nuclear

power in some political parties (Qvist & Brook, 2015) and parts of the Swedish population (Holmberg, 2015) while others think it is the solution. Meanwhile the population in general seems to worry more about what food products contain. As Rosati and Saba (2004) points out, contaminated food are a widespread health problem and also an economic problem since it in many cases leads to lack of trust in food products that which in turn lower demand.

Even if Sweden decides to abandon nuclear power, neighbouring countries continued use of nuclear power could still pose as a threat since spreading of nuclear substances from a potential accident in another country could still affect the Swedish population. At the same time, how to eat healthy and knowingly are topics on every other magazine and related information, accurate or less accurate, has never been easier to obtain.

Given the quite high reluctance to nuclear power in Sweden (Holmberg, 2015), is there a concern regarding radioactive substances in food products? What would explain it? Do individuals follow the recommendations regarding radioactive substances in food? Would consumers be willing to pay to be certain that the level of radioactive substances in food products are below the recommended?

1.2. Objectives

The main purpose of this research is to look at attitudes and perceived risk, the level of concern, for food contaminated by radioactive substances and WTP for a label ensuring that the levels of nuclear substances are below the recommended thresholds set by the National Food Agency in Sweden.

More specifically this report will;

(1) Determine and identify key explanatory variables for level of concern regarding food contamination from radioactive substances.

(2) Determine WTP for a label ensuring that the levels in potatoes of radioactive substances are below the thresholds set by the National food agency in Sweden. Identify the key explanatory variables for WTP for potatoes.

(3) Determine WTP for a label ensuring that the levels in minced beef of radioactive substances are below the thresholds set by the National food agency in Sweden. Identify the key explanatory variables for WTP for minced beef.

1.3. Hypotheses

The hypothesis regarding the first objective is that concern regarding food contamination from nuclear substances will be explained by a set of variables including sociodemographic characteristics, such as age, gender, income, education and attitude to nuclear power. Concern is also assumed to be determined by a set of knowledge and information variables concerning nuclear power and radioactive food contamination. It is also presumed that gender will play an important role since previous studies have shown gender to be connected to perceived risk as well as attitude.

The hypothesis regarding the second objective will be that WTP for potatoes are determined by a set of three main categories of variables, nuclear power knowledge, food information and sociodemographic characteristics. Age is presumed to have a nonlinear relation to WTP since the different stages in life might have different impact on our WTP.

The hypothesis regarding the third objective will be that WTP for beef are determined by a set of three main categories of variables, nuclear power knowledge, food information and sociodemographic characteristics. Age are presumed to have a nonlinear relation to WTP since the different stages in life might have different impact on our WTP. Income should also play a larger role in WTP for beef since it has a higher initial price than potatoes.

1.4. Limitations of the estimations

Data will be collected at two locations in the outskirts of Stockholm, which makes it hard to draw general conclusions since it could be presumed that there could be geographical differences in level of concern and WTP as Drottz-Sjöberg and Sjöberg (1990) concludes for example. The limitations for this study are thus both the number of respondents and the selection of respondents, which will not correspond to a representative sample for the Swedish population. An extended study should take geographical location into consideration when preparing the survey. A larger study should also give the opportunity to further investigate age as an explanatory variable since younger individuals probably have less relation to this matter and therefore age would be interesting to further investigate.

The number of questions and composition had to be kept rather short due to time limitation in the collecting phase, which could influence the analysis of the data.

All limitation are connected to the time limitation of this project. However the limitations do not interfere with the purpose to get a preview of an interesting topic that need more research and to give an indication of what could be a possible outcome if a larger survey was done with a representative sample.

1.5. Outline of the report

The outline of the report of this research is arranged as following. First a literature review will follow including explanations of the concepts used in this research, including WTP, risk perception and some basic background information from the Chernobyl accident, as well as previous studies. After that chapter three, follow with a discussion of the ethical dilemma in the topic, the proposed variables, as well as a description of the questionnaire used and this chapter will be closed with a description of the econometric approach, including regular OLS as well as the more advanced ordered probit model, used to be able to make a useful analyse. Chapter four includes a description on how data was collected and also a description of the data that will be used in the analysis corresponding to the objectives. Chapter five includes the result, the main findings for level of concern as well as the main findings for WTP for both potatoes and minced beef. The result is presented separately for each objective and then follows chapter six with a discussion about the result and some comments on how to proceed with future studies in the area. Chapter six ends with a short summary and some concluding remarks.

Chapter 2 – Literature review

The literature review begins with a briefing of the effects of the nuclear accident that mostly influenced and affected Sweden, namely the Chernobyl accident. The Fukushima accident was a tragedy for the surrounding areas. However the impact on Sweden and especially the food sector was not by far as extensive as the impact from Chernobyl. Another factor for the importance of Chernobyl is time, the time since Chernobyl has given opportunities to perform studies of the effects but the time span since Fukushima is still to short to make it possible to look at long-term effects. Therefore the effects from Chernobyl are more thoroughly presented to give a background to the respondents' previous experiences in connection to nuclear power. After that a section of risk perception follows to give an understanding of human perception of risk in general but also in connection to nuclear power and food hazards. The review ends with a section about WTP, how it works and why it would be a good measure to capture the second and third objective of this study.

2.1. The effects from the Chernobyl accident on nature and humans

After the accident at the Chernobyl nuclear power plant, winds spread radionuclides around the world. Fallout with rain gave an uneven distribution of radionuclides with contamination far from the site possible. The nuclides that spread from Chernobyl was a variety of several types with different half-lives, some just a couple of hours, others thousands of years. But the most interesting in a longer perspective was caesium 137 (Mascanzoni, 1987). Caesium 137 has a half-life of 30 years, which means that in 30 years half of the initial amount remains, and after 60 years the amount is one quarter (Moberg, 2001). This would imply that half of the initial amount that landed on Swedish ground is still present. Becquerel, Bq, is a unit for radioactivity and stands for decomposition. One Bq corresponds to one decomposition per second (Nationalencyklopedin, 2016).

Approximately five percent of the caesium 137 that spread from Chernobyl ended up on Swedish ground, with the highest concentration of 200 Bq/m^2. The amount of rain determined where the most contaminated areas were in Sweden. The most contamination was found in Västerbotten, Västernorrland, Gävleborg, Uppland and Västmanland, all in the middle and northern parts of Sweden. Ceasium 137 was bounded to particles in the soil and sediments in lakes. Most of those reserves are not likely to spread; however some might have been available for uptake in animals and plants (Moberg, 2001). Countermeasures can

be used to reduce caesium levels in animal products, such as change the pasture to less contaminated areas, feeding with non-contaminated food, change the slaughtering time or to use binders for caesium (Tveten et. al. 1998).

Kryshev (1994) analysed radionuclide accumulation in waters and found that the balance were off for quite some time after the Chernobyl accident. Radionuclides enter waterways in two ways, from fallout from the air and from water-catchment areas. Contaminated waterways can contaminate fishes, bottom sediments and aquatic plants. This can, of course, affect water life but also humans through the food chain. Yablokov et al (2009) found that the annual mean of caesium-137 in surface water outside of Gotland increased from approximately 20 Bq/m^3 to around 150 Bq/m^3. Even in 2004 the annual mean was still almost the double amount as initially.

Fishes were most exposed in waters with low circulation. It gives nuclides the opportunity to accumulate, and therefore low circulation became a bigger risk for exposure for fishes. The highest amounts were reported in trout, bream, char and perch. As for wild animals, substantial differences in individual levels of radionuclides were found in fishes, even between fishes of the same species living in the same lake (Mascanzoni, 1987).

Contaminated areas increases the amount of mutated animals compared to uncontaminated areas. The heavily contaminated areas show an increase in morbidity and mortality in both wild and domesticated animals. In the Polessk District, located near the 30 kilometres radio of Chernobyl up to 22 percent of all insects collected were malformed in 1990. Malformed insects could also be found in Gävleborg in Sweden and Switzerland (Yablokov et al. 2009).

Animals that graze closer to the soil, such as goat, lamb and sheep showed increased amount of caesium-137. For bovine, horses and pig the amount was quite low but for wild animals the variation was substantial (Mascanzoni, 1987).

During the sixties reindeer meat was examined due to their pasture of lichens which was contaminated as a result from nuclear bomb testing. In the mid sixties the levels of caesium was relatively high. It wasn't until 1980 the levels of caesium decreased below the threshold of 300 Bq/kg. After Chernobyl, reindeer were one of the most affected animals in Sweden. The high amount of radioactive substances led to control programs at slaughterhouses

(Mascanzoni, 1987). During the first year after Chernobyl up to 78 percent of the reindeer meet in northern Sweden had to be discarded due to the high levels of caesium-137 (Bostedt, 2001).

The levels of caesium in milk were in general quite low. Tveten et al. (1998) explains the low levels with the fact that most cows at the time of the accident were still inside in barns and would still be for a few weeks before going on their summer pasture so that the levels of radionuclides with shorter half-lives had time to decompose. If the accident happened a few weeks later the situation could have been very different. However an increased level of radioactive substances was detected in goat milk in Norway during the summer of 1986 after the goats started to graze higher up in the mountains. The increased levels led to goat milk that could not be used, a main input in the popular brown cheese, and was instead used for animal feed. This led to economic losses up to NOK 10 millions in 1986 and NOK 7 millions in 1987.

The levels of caesium 137 in grains were as for milk quite low, probably due to agricultural activities such as tillage, which moved the nuclides from the surface further down in the soil making it available to the root, where uptake is lower (Mascanzoni, 1987).

Cloudberries showed levels of caesium-137 above the recommended. The reason was that they grow mainly on peat soils. In the case of mushrooms the concentration seems to be highly influenced by the characteristics of the soil in which the mushrooms were growing (Mascanzoni, 1987).

Food contamination has in many cases led to decreased demand for those food products and a loss in confidence in quality of food products (Rosati & Saba, 2004). Bostedt (2001) found a strong negative effect on demand for reindeer meet due to Chernobyl, with a backward-sloping supply curve, which the author explains by large herds. This supply could lead to an unstable equilibrium price, however that did not seem to be the case the supply response was instead influenced by the intrinsic utility of the Sami.

Other sectors in Sweden were also affected, for example tourism. Hultkrantz and Olsson (1997) states that since most foreign tourists are interested in nature in Sweden, tourism is vulnerable to environmental damage. They found a decrease in tourism in Sweden

connected to Chernobyl, however within the foreign group there were differences where some nationalities showed a decrease in tourisms and some did not. Tourists from Norway and United States were two of the subgroups that showed a decrease in tourism in Sweden. An estimated value of the economic losses due to the decrease in stays at hotels and hostels were SEK 2.5 billon in total during the time period of June 1986 to December 1989.

The National Food agency in Sweden (2016) concludes that the amounts of radioactive substances in food products today are safe. However they raise the fact that wild boar has shown to contain raised levels of caesium-137 in areas most contaminated after Chernobyl. As a report from Rosén and Weimer (2012) show, wild boar have started to relocate to areas in Sweden that was contaminated from Chernobyl, this could lead to increased levels of caesium-137 in wild boar. Test has shown that some individuals contain higher levels than was recommended, however as for other species, a wide range of concentration were found in the tested animals.

Rabl and Rabl (2013) have calculated the cost of a potential nuclear power accident based on the two most severe, Chernobyl and Fukushima. Their result shows huge economic losses in several categories. The loss of electricity is estimated to be equal to 90 TWh, at 0.2 €/kWh. Fatal cancer cases are estimated to be 10,000, with a value of five million € per patient. Agricultural land is assumed to be unsuitable for production the following 100 years after an accident with a corresponding area of 1000 km^2 with an estimated loss in production corresponding to 120,000 €/km^2 per year.

2.2. The perception of risk of nuclear power and food hazards

A nuclear accident could affect public acceptance. Visschers & Siegrist (2013) investigated the effect on public acceptance and what the determinants are. By using a before and after approach in connection to the Fukushima accident they could see the effect of Fukushima on public acceptance in Switzerland. They found a negative effect on public acceptance after Fukushima. The result also showed that perceived risks and benefits were determinants for acceptance before and also after the accident. Trust was strongly correlated to risks and benefits both before and after the accident.

Trust in information about food safety and the public perception of risk is two factors influencing consumers' reaction to food-related hazards. Taking these into account more

efficient food polices could be used to keep consumers trust in food safety. A gap between scientists' assessment of risk and public perception of risk could be low trust in reliability of information. Trust is linked to risk perception and determined by perception of knowledge and expertise, concern and care amongst other. Trust can be determined by concern, and knowledge (Rosati & Saba, 2004). Huang (1993) draw the conclusion that to get it right some kind of education or information program should be needed.

During the time span 1986-2014 a larger share of the Swedish population wanted to phase out nuclear power than those wanting to keep nuclear power, except between 2002 and 2010 which was the only time span where the opposite relation was found. A peak was found in 1986 with the highest amount of wanting to phase-out, 75 percent, whereas in 2014 the share of wanting to phase-out was 49 percent (Holmberg, 2015). Drottz-Sjöberg and Sjöberg (1990) found a strong negative effect regarding attitude towards nuclear power after the Chernobyl accident. Nuclear power and radiation were rated among the worst risks. Respondents in Gävle, an area heavily affected by the fallout, reported twice as often as others worries about getting ill due to the fallout. Farmers were the most negative subgroup and women were more negative than men. Around 35 percent of the respondents thought that a similar accident would happen in Sweden before 2010. Swedish preparation for a nuclear accident was estimated to be very or rather good by less than 20 percent of the respondents. However even the concerned participant could agree to the economic benefits of nuclear power.

The Chernobyl accident resulted in a decreased public acceptance of nuclear power around the world, where Yugoslavia was one of the most extreme cases with an increase in opposition from 42 percent to 78 percent. Other examples were Finland and Greece with an opposition increase with around 30 percent. However in France the corresponding number was only 12 percent. It seems that there could be a correlation between fallout and acceptance. This implies that the public could make a rather accurate perception of the risks (Drottz-Sjöberg, 1991). Ivanova (2014) examined how the public opinion was affected by Fukushima in 2011 and found that the Fukushima accident had a negative impact on public opinion. It also seems like there is a reverse NIMBY (not in my backyard) situation. When distance to a nuclear power plant increases, public opinion on nuclear power tends to get more negative.

During 1986-2014 Swedish women have been more in favour of phasing out nuclear power than men. In 2014, 55 percent among women wanted to phase out while the corresponding number for men was only 42 percent. Respondents between 50 and 64 years of ages were the age group with the highest amount in favour of phasing out with 55 percent. The lowest number of respondents in favour of phasing out were 16 to 29 years of age with 44 percent in favour of phasing out. The other two groups, 30-49 years and 65-85 years, had a share of 47 percent and 49 percent respectively in favour of phasing out (Holmberg, 2015). In general women perceive higher risks than men. Younger individuals, especially men, perceive lower risks than older ones. When it comes to nuclear wars, younger individuals seems to rate nuclear war high on their perceived risk of great worries. However those who spend a lot of time thinking about the possibility of nuclear war were also experiencing that they could have an influence on the matter (Drottz-Sjöberg, 1991).

Yun et al. (2016) conclude that knowledge and education could lead to a decreased perceived risk regarding nuclear power and a lower WTP to reduce hazards from nuclear power. Subject of higher education seemed not to have a significant influence on the lower perceived risk.

Rowe et al. (2000) state that the perceptions of risk in the public are closely linked to medias report. Public negativism is affected by the coverage from media and the level is linked to the volume of reporting from media. At the 10th anniversary of the Chernobyl accident Rowe et al. (2000) examined how the media covers a number of hazards before, during and after the anniversary. In total, 20 potential hazards were included. During this time period two hazards were not of central focus in any newspaper, where one was *food contaminated by radioactive substances.* Main findings were that a Swedish newspaper on average reported four times more about the chosen hazards than the average English newspaper. The most reported hazard was BSE and reports on both Chernobyl as well as other nuclear connected hazards were not in top in Sweden nor in the United Kingdom. The author presents a theory explaining the result that in Sweden there is a real and cultural interest in risk issues and that Sweden has a "safety culture" which would then explain the four times higher rate of hazards in general. However as Drottz-Sjöberg and Sjöberg (1990) reports right after Chernobyl, in late spring between 10-25 percent of the news on radio and television, measured in time, concerned Chernobyl. Attitudes can evolve in line with media coverage

and information. Where media can increase risk awareness and public opinion can reflect the perceived weight put on certain risks by media.

Tucker et al. (2006) preformed a survey in the US where respondents were asked to state the perceived risk of several food safety risks. Respondents listed pesticide residues in food and contamination of drinking water with the highest risk. Mad cow disease and genetically modified foods were listed with the lowest amount of perceived risk. Rosati & Saba (2004) found that irradiated food and genetically engineered food were the least know hazards and were therefore least avoided. Instead mad cow disease, and bacterial contamination were most known and avoided. Perception of food risk was a combination of perceived personal risk and an individuals own knowledge about potential food risk.

Perception of risks and knowledge connected to nuclear power where the subject for Kim et al. (2015). 77.2 percent of the respondents avoided purchasing food products from Japan, where women took a larger share of those. Of those who avoided purchasing food products from Japan 60.8 percent avoided all kinds of food from Japan and 35.7 percent only avoided seafood. 34.4 percent consider China to be connected with the highest risk among the surrounding followed by North Korea and then Japan, which could be explained by distance or closeness. Exposure to air, rain or seawater and ingestion of food or water were noted as the main risk factors by the respondents for their health. Almost half of the respondents would like to participate in food safety education concerning contamination due to radioactive substances.

Tonsor et al. (2009) examined how consumers rely on different food safety information when buying beef. Overall Japanese consumers had higher risk perceptions than both the US consumers and the Canadian consumers. Consumers that rely on observable attributes and put more trust in doctors for food safety information had lower risk perception. Consumers in both the US and Japan are more influenced by credence attributes than observable. Ekelund et al. (2014) discuss the problems with what information consumers are facing in the stores. Getting people to decrease their carbon emissions through food habits, they should firstly be aware of the impacts of climate change and how they individually could be affected. Then they could become interested in how their actions could contribute and weight it to their situations with cost and benefits and self-efficacy.

As Westerlund & Lund (2006) points out there are several attributes that can appeal consumers and depending on what is most important to the consumer the choice of product can differ. In the case of choice of pork in Sweden, those preferring imported pork did so because of a lower price. Overall the most important criterion seems to be to enjoy the food. However those who purchase branded and local-organically produced, animal welfare is an important attribute in the decision process. Consumers that prefer branded and local-organically products are more involved as consumers.

Samant and Seo (2016) showed that consumers with knowledge about food labelling and labels, used the labelling in the decision process and expressed more trust in the products than those without knowledge. They concluded that with greater knowledge about labelling consumers can be provided with tools to increase positive purchasing behaviour.

2.3. What people are willing to pay and why

Grande (1999) lift the possibility that experts and consumers calculate risk differently and that consumers are concerned about food on the market and are willing to pay an additional amount to avoid contamination. Even though governments claim the food on markets to be safe, consumers still perceive a risk and a fear to consume these products.

WTP corresponds to the maximum amount a consumer would be willing to pay for a particular product (Echeverría et al. 2014), the extra amount for a good. The difference between that amount and the actual price can be seen as the consumer surplus (Grande et al. 1999). WTP is considered as a good method that best corresponds to the economic theory (Roberts, 2007) and are often used to capture a monetary value for nonmarket goods or attributes (Yu et al., 2014). One way to do this is using a survey and ask participants to express their WTP in relation to a hypothetical situation (Echeverría et al. 2014).

Individuals' choices are driven through implicit as well as explicit motives. Where the implicit are those grounded deeply within our personalities and often grounded in early life whereas the explicit motives are goals or views that we consciously set for ourselves, how we want to act. Influences from norms and our surroundings can evolve throughout life. These two types of motives can explain decision making (Yu et al., 2014). By labelling a product consumers can make informative purchasing decision (Echeverría et al. 2014).

Yu et al. (2014) examined the influence of time pressure and cognitive load on WTP, since these two things seems to intervene with the human decision process and could reveal the motives behind our decisions. The author found that time pressure did not seem to interfere with WTP, however WTP were sensitive when introducing cognitive load, in this study they used interruptions as a cognitive load. They conclude that implicit motives, which cognitive load can make dominate the decision process, make WTP to decrease.

Finding values for nonmarket goods through stated preferences can be difficult. Individuals tend to respond with how they would like to behave, not necessary how they actually would behave in an real situation. Asking for WTP for a hypothetical situation could lead to hypothetical bias. A possible solution to this could be using what is called a cheap talk script. By mentioning the issue of overrated WTP respondents might take that into consideration when stating their WTP (Carlsson et al, 2013).

Carlsson et al. (2013) found that using an oath script in an contingent valuation survey, the variance in the stated WTP decreased. However respondents might, although some type of script, still answer to protect their self image, answer strategically or just protest to the research.

WTP are sensitive to the product in the sense that depending on the products share of the households' expenditure the WTP could vary. This is connected to the fact that if a product has a small share this will give a price elasticity that is inelastic, demand will not be that affected to price changes. Demand for products with a high share will therefore be more sensitive to price changes. This is interesting in the case of WTP because it would give a higher WTP for low share products and a lower WTP for products with a larger share of the households' expenditure (Echeverría et al. 2014).

Andersson et al. (2015) examine the valuation on individuals' preferences for reducing the morbidity risk in Sweden, by using contingent valuation method and estimate a value of statistical illness. They also examine how WTP changes due to expected changes in quality-adjusted life years, QALY. They found a WTP between SEK 13-39 per kilo for a chicken product that reduces the risk of an salmonella infection, which corresponds approximately to a 10-30 percent price increase. The relationship between risk reduction and WTP is weak and the authors explain in with the small difference in risk changes between the scenarios. A

strong relationship between WTP and the size of the change in QALY when the outcomes were non-fatal were found, however when the outcome was mortal no significant result was found.

According to Grande et al. (1999) groups that reported higher WTP for uncontaminated food products can differ depending on country. In Norway people who preferred buying organic products, having experienced food poisoning, women and younger are more willing to pay extra for uncontaminated food whereas in Scotland the two first groups are present but not the latter to instead those without children under 20 years of age, small household sizes and those with education outside natural sciences.

In Grande et al. (1999) they assumed that consumer perceived some risk connected to consumption of some types of food products that were amongst the more contaminated. Some parts within these food products were treated with countermeasures but which ones were not labelled and therefore a consumer could not be certain if the food product were treated or not. They asked for WTP for labels that ensured that the radioactive substances were below the recommendations set by the National Food Agency in Sweden.

Grande (1999) addresses the problem with radioactive contaminated food, perceived risk and WTP to avoid contaminated food by determine if there is a fear for radioactive contamination in food and how much consumers in Norway and Scotland are willing to pay for “clean” food. Norwegians were most concerned about radioactivity in reindeer meet, wild mushrooms and elk meet, whereas the Scots were most concerned about wild mushrooms and berries. Norwegians perceived higher risk. Of the Norwegian respondent, 40.4 percent made a short-term reduction in consumption of wild mushrooms whereas the corresponding number of the Scots was only 19 percent. By using a WTP approach it could be shown that Scots were willing to pay 31 percent more for “clean” lamb whereas Norwegians were willing to pay 46 percent more.

Further finding in Grande (1999) were for risk perception that Norwegian consumers who perceived higher risk and took action to reduce risk had for example lower household income, small households, older, women and preferred buying organic food. On the other hand those who perceived lower risk and did less to reduce the risk were for example those

with higher household income, large household, were younger, men and had a college or university degree.

2.4. Contribution to the literature

This research will contribute with an updated view on the perception of risk connected to nuclear power in Sweden, more specifically, a contribution on how radioactive substances in food products are viewed and if consumers are concerned about contamination from radioactive substances. In recent years this is not something that has been thoroughly studied, this research will give an introduction to the current situation regarding this. However to be able to draw general conclusion for the entire population in Sweden, a larger sample would be needed. The angle of this research towards food products is something that has been missing in the literature where most effort has been put on looking at overall attitudes towards nuclear power. Not much effort has been put on investigating the attitudes towards the real and potential side effects from nuclear power production.

This research will also look at WTP for a label on minced beef and potatoes ensuring that the levels of radioactive substances are low enough in food products and what could explain WTP. Similar studies have been preformed in Norway (Grande, 1999) for example. In Sweden however this has not been investigated recently, or maybe at all, and this research contribute by giving an indication on how the situation today looks like and also what would be interesting to extend in further research.

The combination of these two approaches is interesting since perception of risk and effort to avoid a certain risk might not be driven by the same forces. In addition they could capture different things that might be worth in decision processes for further research.

2.5. Conclusion of the literature review

In the literature review mainly three topics has been discussed. The review started off with a background on the impact of the nuclear power accident at Chernobyl. The effects were even though the distance to the nuclear power plant quite large in Sweden. Moberg (2001) states that as much as 5 percent of the nuclear substances ended up on Swedish ground, with large variations in concentration.

As some of the authors (Rosati & saba, 2004; Grande, 1999) presented in the review conclude, risk perception between experts and the public might not always be consistent. Therefore it is an interesting topic even though the National Food Agency in Sweden claims most food products have levels of radioactive substances below the critical level (National food agency Sweden, 2016).

A potential accident could have severe impact on specific markets, (Bostedt, 2001), and the fact that before an accident it is hard to predict what will be the consequences due to for example fallouts, (Moberg, 2001), and time of year (Tveten et al. 1998) makes it a topic of interest. It is hard to predict what consequences a potential accident could have in a society and makes it even harder for a consumer to make an accurate risk assessment of nuclear power as well as the risk regarding food products.

Chapter 3 – Conceptual issues and empirical implications

A survey is used to get the needed data to test the hypotheses. The responses from the survey will be analysed using different types of econometrics models, since the nature of the dependent variables is in need of different models. This chapter present a review of the questionnaire and the econometric models used. Given the findings in the literature review a frame for the modelling will presented first. Through the literature review a set of variables were determined as independent variables with potential explanatory value and divided into subgroups, these are presented in the presentation of the questionnaire. The extended explanations, and the question behind the variable, are presented in the data description.

3.1. Development and specification of the models

The objectives correspond to three dependent variables. These variables will be connected to a variety of independent variables, or explanatory variables. All variables are presented in table one. The idea is that the independent variables will in different sets be tested to see if and how they can explain the particular dependent variable.

Given the findings in Grande (1999), Yun et al. (2016), Holmberg (2015), Drottz-Sjöberg and Sjöberg (1990) sociodemographic characteristics could be important variables for risk perception as well as WTP. Given the findings in Rosati and Saba (2004) and Yun et al. (2016) knowledge can be a key variable to explain concern and WTP, leading to a set of variables concerning previous events in the nuclear sector and current events and policy decisions. As Rosati and Saba (2004) finds, perception of food risk can be explained by knowledge about food risk so use recommendations and searching for information regarding food contamination from radioactive substances could be potential independent variables as well.

Table 1 - Presentation of the variables

Dependent variable	Subgroup for independent variables	Independent variable
Concern	Sociodemographic characteristic	Age
WTP potatoes		Gender
WTP beef		Children
		Size of household
		Education
		Income
	Knowledge	Radiation_equipment
		10_active_reactors
		Ringhals
		Phase_out_2010
		Longrun_phase_out
	Information	Origin
		Food_recommendation
		Food_info_Chernobyl
		Food_info_Fukushima

Level of concern is a qualitative variable, where the levels of concern ranging from strongly disagree to strongly agree has a natural ordering but not any natural numerical values. According to Stock and Watson (2012) regular OLS is an inappropriate method. For qualitative dependent variable, with more than two possible outcomes, ordered probit model is a better method to use when determining the causal effects between a qualitative variable and the corresponding independent variables. Ordered probit model will be further discussed later on.

WTP is a quantitative variable which makes OLS an appropriate method to calculated the causal effects.

When surveys and questionnaires are used it is important to reflect on ethical matters. As Ejlertsson (2005) points out, it is always good to consider ethics before performing surveys with humans. Especially four criteria should be considered, information, agreement, confidentiality and usage. The participator should be informed of the purpose of the survey, the aim and that participation is voluntary. The participators has to agree to participate, their personal information has to be handled

in a way so that no third part could connect information to a specific individual and the usage of the information collected has to be in line with their agreement.

Ethical matters were considered during the process of developing the questionnaire as well as in the interaction with the respondents. In short, it will be discussed further later on, this was done mostly by the first page where the participator faced information about the aim of the study, that their information should not be presented in such a way that it could be traceable and that it was clear that participation was voluntary. For those who wanted more information, all questions were answered in such a way that these things were considered.

3.2. The questionnaire

The full questionnaire is presented in the appendix. In this section the questionnaire will be presented shortly with some comments about the structure. All questions were not used as variables in the analysis later on, some of them were included to get a feeling of the sample. The questionnaire was in Swedish therefore some nuances in the language might have been lost in the translation.

3.2.1. Structure of the questionnaire

The respondents got a cover with a shorter presentation of the subject and a short description of the aim of the study. Since, as discussed in the ethic section, according to Ejlertsson (2005) it is important to inform the participant of the aim of the research and some information. The presentation of the project should include a short explanation of the aim of the study, it should also point out that answers are confidential and include a phrase of gratitude for participation (Ejlertsson, 2005). This was taken into account when formulating the cover letter, with the addition of a reminder to make sure to answer all questions.

The cover letter was held rather short to make sure that the uptake of the respondents' time could be held at a minimum. Since all questions could be answered instantly it justified a shorter introduction. The cover letter is presented in a translated version below.

Survey regarding energy policy and food contamination with radioactive substances

Dear sir/madam,
We're conducting a survey regarding nuclear power policy, swedes nuclear attitudes and food contamination from radioactive substances. It would be of great help if you would like to participate. All answers will be confidential. Please, make sure to answer all questions.

Thanks in advance!

The questionnaire consisted of four pages, were the first included a description of the aim and subject and the last page was a thank you note. The two pages left contained the questions that was going to be used as variables later on.

The questionnaire did not include any open-ended questions. This is a good approach according to Trost (2012) to avoid long, time consuming answers, but also to minimize the risk of misinterpretation of someone's handwriting. It also decreases the risk of respondents skipping questions due to insecurity to express themselves in writing. This was crucial when writing the questionnaire since the collection was outside of a supermarket and time to answer had to be quite short to convince respondents to participate. Since the participant answered on a physical paper it was crucial that the answers could be interpreted afterwards as there would be no opportunity to correct any errors or misunderstandings.

3.2.2. The components of the questionnaire

The questions were divided into four subsections, nuclear power, food information, WTP and demographics. These will be discussed further separately. Since as Trost (2012) concludes, too many questions with the same alternatives and set up can make a respondent perceive it as difficult and unpleasant the number of questions was limited.

Nuclear power, knowledge and attitude
Under the section of nuclear power the aim was to capture level of knowledge on historic events in the nuclear power sector. All questions were statements that the respondents took a stand to and then answered to what extend he or she agreed with the questions. A likert scale with five options from strongly disagree to strongly agree with a neutral alternative in "neither" was used. The section contained two questions that was supposed to capture

knowledge on historic events such as the fact that the accident in Chernobyl was internationally discovered when the nuclear power plant Forsmark in Sweden detected increased levels of radioactive substances or the decision to close all nuclear power plants in Sweden until 2010. Two questions were included to capture more recent events, the share of nuclear power in Sweden today and a recent decision to close two reactors earlier than planned. An attitude question was also included, more particular if the respondent thought that nuclear power should be abandoned in the long-run. A similar question is included in the yearly survey presented by Holmberg (2015). This gave an opportunity to see similarities between the samples.

Food information connected to nuclear substances and risk perception

The aim of the section on food information was the capture how the respondents perceived risk in connection with radioactive substances, if they actively searched for information regarding food safety generally and in connection to radioactive substances.

Rosati and Saba (2004) conclude that there is a dependence between worry and risk perception and therefore in this set up concern will function as a synonym to worry and therefore as a risk perception indicator. Level of concern was measured through a statement to which the respondents had to choose a level of agreement to the statement.

In addition, the section contained of statements as if the respondents look for food safety information in connection to Chernobyl and Fukushima. Also included was a question about usage of the recommendation from the National Food Agency in Sweden, regarding nuclear substances in food products and a general question about food information regarding origin of the product.

WTP for potatoes and minced beef

As mentioned in the literature review, WTP is the maximum amount a consumer is willing to pay for a product (Echeverría et al., 2014). WTP could be interpreted in two different ways. It could be willingness to pay to gain a benefit or willingness to pay to avoid an undesirable outcome (Boardman et al. 2014).

In the third section of the questionnaire the respondents were facing two questions on WTP, a stated preferences approach where the respondents are asked to state their WTP. The two questions on WTP concerned potatoes and one for minced beef. The two food products were

chosen to represent products in everyday food consumption in Sweden. As Echeverría et al. (2014) points out, it is important for the respondents to be familiar with the product as well as the initial price has to be known. It can also be good to look at different products with different budget shares.

Minced beef were chosen since it is a good that is commonly used and also a cutting detail that is commonly known. In contrast to many other cutting details minced beef has a lower price however the total expenditure might be larger since it might be a larger consumption than other details. This makes it a good that could work as one with a bigger budget share, especially in contrast to the other good, potatoes.

As mentioned in the literature review reindeer meat was one of the most affected food products in Sweden after the Chernobyl accident. This was taken into account in the process of developing the question, however reindeer meat in Sweden is a small part, if any, of the regular consumer's food intake, therefore in line with Echeverría et al. (2014) minced beef was chosen as a product which the respondents were more familiar with. The other question on WTP was on potatoes, a common food product in Sweden, due to its rather low price per kilo it would be presumed to have a lower budget share than minced beef.

In the question both goods were represented with an initial price, to give a reference point and also to make sure that all respondents emanated from the same starting point when valuing their WTP. The respondents were then facing six alternatives corresponding to an interval in SEK. All presented in table two.

How much would you be willing to pay extra for 1 kilo of potatoes/minced beef with a label ensuring that the value of radioactive substances are below the recommendations set by the National Food Agency in Sweden? Assume a price of SEK 9.90/SEK 79.90 per kilo.

Table 2, Alternatives for questions on WTP

	WTP Potatoes	WTP Beef
Given price	SEK 9.90 per kilo	SEK 79.90 per kilo
Alternatives, SEK/kilo	SEK 0	SEK 0
	SEK 1-2	SEK 1-4
	SEK 2-3	SEK 4-7
	SEK 3-4	SEK 7-10
	SEK 4-5	SEK 10-14
	SEK 5 or more	SEK 14 or more

Sociodemographic characteristics

The last section of questions contained a set of question aiming to capture the demographics of the respondents. In this section the respondents were asked to state age, gender, children below 18 years old, the size of their household, education, occupation and household income. In order to reduce the risk for traceability due to the small sample size, the categories for some of the alternatives were rather large for some variables. In addition, this strategy also made the analysis easier.

This section was of particular interest since age, education, gender etc. often can explain risk perception (Drottz-Sjöberg and Sjöberg, 1990; Holmberg, 2015; Drottz-Sjöberg, 1991;Yun et al., 2016).

3.3. The econometric approach

The hypotheses will be investigated through several econometric models, presented below. Risk perception is a qualitative variable and calculations will be done through ordered probit model. WTP is a quantitative variable and will be analysed through OLS, ordinary least square.

3.3.1. Ordered probit model

The econometric analysis regarding the first objective will be done using ordered probit model. When dealing with ordinal dependent variables where the choice variable is an opinion survey the usual multinomial logit or probit model will fail to correctly estimate the model (Greene, 2000). If not ordered probit model is used, important information is lost since the relation between the outcomes is not accounted for (Franses & Paap, 2001).

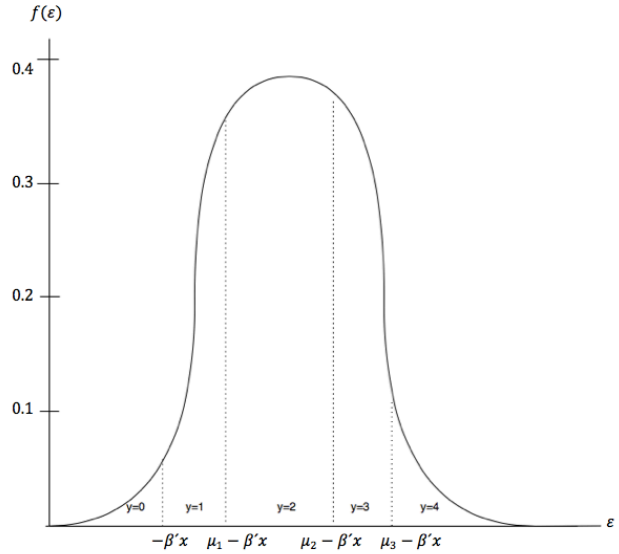
In surveys the questions can often be answered on a likert scale, which is a scale of options that are ordinal, they can be ranked internecine but we cannot say that for example that the option corresponding to two is twice that of one (Gujarati, 2004). Level of concern will be measured on a likert scale unlike WTP, which makes ordinary OLS appropriate for WTP and ordered probit appropriated for level of concern.

It would have been possible to measure concern for food contamination from radioactive substances as a binary variable, where the respondents' only choice would be yes or no. However, in such a complex matter it is very likely that more useful information could be captured if the respondent gets several options to state their level of concern and not just only if they are concerned or not. Therefore a likert scale was used.

Greene (2000) states that ordered probit is based on the probability of falling into one of the outcomes. With a normal distribution the probabilities for the outcomes are given by the following expression:

$$
\begin{aligned}
Prob(y = 0) &= \Phi(-\beta' x) \\
Prob(y = 1) &= \Phi(\mu_1 - \beta' x) - \Phi(-\beta' x) \\
Prob(y = 2) &= \Phi(\mu_2 - \beta' x) - \Phi(\mu_1 - \beta' x) \\
&\vdots \\
Prob(y = J) &= 1 - \Phi(\mu_{J-1} - \beta' x) \\
0 < \mu_1 &< \mu_2 < \cdots < \mu_{J-1}
\end{aligned}
$$

In this set up Φ represents the standardized cumulative distribution function (Dosman et al., 2001). μ is an unknown parameters, β represents the coefficient for a specific explanatory variable, β and μ are calculated simultaneously. The threshold is the point, or break, between two outcomes (Greene, 2000).



Authors own replication from Greene (2000).

Figure 1 - Probability distribution for the ordered probit model

Figure 1 represents the probability distribution for a model with five outcomes categories. The formulas underneath represent the threshold between the outcomes categories, a change in one of the explanatory variables shifts the probability curve either to the left or to the right depending on the impact of the explanatory variable. This makes changes in the distribution (Greene, 2000).

The marginal effects of an independent variable indicate the change in probability of falling in a particular outcome category in response to a change in that independent variable. The marginal effects are computed from the estimated coefficients, but not equal to the coefficients. A shift in one of the independent variable will shift the distribution of the outcome; the curve in figure 1 will shift either to the left or to the right (Dosman et al., 2001). For example, increasing one of the independent variable, while holding β and μ constant will shift the distribution of Y. if β is positive then the probability (y=0) will decrease. The interpretation of this type of regression is not as easy as other types. What happens with the prob(y=0) and prob(y=J) when one of the explanatory variables changes can be relatively easy to interpret with the signs of the coefficients. However for the outcome categories in the middle, it is harder to interpret because the densities have to be taken into mind to make a useful interpretation (Greene, 2000).

The marginal effects are calculated by derive the partial derivative of each explanatory variable as following:

$$\frac{\partial Prob[y=0]}{\partial x} = -\phi(\beta' x)\beta$$

$$\frac{\partial Prob[y=1]}{\partial x} = [\phi(-\beta' x) - \phi(\mu_1 - \beta' x)]\beta$$

$$\frac{\partial Prob[y=2]}{\partial x} = [\phi(\mu_1 - \beta' x) - \phi(\mu_2 - \beta' x)]\beta$$

$$\frac{\partial Prob[y=3]}{\partial x} = [\phi(\mu_2 - \beta' x) - \phi(\mu_3 - \beta' x)]\beta$$

$$\frac{\partial Prob[y=4]}{\partial x} = \phi(\mu_3 - \beta' x)\beta$$

(Greene, 2000)

The marginal effects should sum the zero since the probabilities sum to one (Greene, 2000).

A binary variable cannot be calculated as other types of variables since it can only take on two different values. Instead the marginal effect are calculated by comparing the probabilities from when the binary variable takes on one value, holding the other variables at their sample mean, with the probabilities from when the binary variable takes on the other possible values, holding the other variables at their sample mean (Greene, 2000).

3.3.2. Ordinary least square

The second and third objective will be analysed through regular OLS, ordinary least square. This estimator provides coefficients for the variables so that the estimated line follows the observed data as closely as possible. The coefficients, or OLS estimates, are calculated using a formula presented below (Stock & Watson, 2012):

$$\hat{\hat{\beta}} = (X'X)^{-1}X^1 y$$

To see how well the model explains the data, R^2 is one measurement commonly used, however it is often more appropriate to use the extended version which is called the adjusted R^2, which takes into account the number of variables. The regular R^2 could rise when including additional independent variables to a model even though the model cannot explain anything more. The adjusted accounts for number of variables and therefore it is more appropriate. However the aim should never be to try to maximize the adjusted R^2 without any intuition behind the decision. The decision to including additional variables should be

based on a theory that the variable would help to better explain a causal effect (Stock & Watson, 2012).

The explanatory variables coefficients explain the change in the outcome variable, Y, when the explanatory variable, X, changes one unit while holding the other variables constant (Stock & Watson, 2012).

Multicollinearity is a potential problem with multiple regression models. However if there is imperfect multicollinearity, it is possible to estimate coefficients however they might be affected, and the estimation might be imprecise. Imperfect multicollinearity leads to a higher variance in the coefficient. Variance inflation factor, VIF, is a test for multicollinearity, which makes it possible to reject perfect multicollinearity (Stock &Watson, 2012).

Chapter 4 – Implementation and data description

The survey was implemented during a couple of days in May 2016. In chapter four a description of the collection process is presented. The data sample from the survey is presented in terms of absolute and relative numbers of the total sample.

4.1. Data collection

Data collection was done outside two supermarkets. People were approached on their way into the supermarket. The location was chosen to get respondents with a mind set on food and those most involved in purchasing food products in the household.

Before the final questionnaire was implemented a trial run was conducted to learn the time frame that could be expected, and if that was reasonable, and also learn what made respondents wanting to participate and their response to the types of questions. The trial run was done using an earlier version of the questionnaire and after some smaller changes hade been done in the questionnaire. From the trial run it became clear that the time it took for the respondents to answer varied a lot, but in general an average around 3 minutes could be expected. Also some different phrases were used when potential respondents were approach. People seemed to be relaxed and positive to the survey as soon as they understood that it was not an advertising brochure and that their participation was anonymous.

Data was collected at two locations: ICA Kvantum Väsby, in the central parts of Upplands Väsby north of Stockholm and ICA Kvantum Arninge, in the outskirts of Täby north of Stockholm. Two locations were chosen to show possible differences. The locations were chosen so that they would be the same size of the store, ICA Kvantum is a concept within the ICA-concern which require a certain standard and assortment.

The collection was made at five different occasions in May 2016. At ICA Kvantum Arninge, data was collected at two dates, one in the middle of the day and one later in the afternoon/evening. At ICA Kvantum Väsby data was collected on three occasions, where the first one was in the middle of the day and the last two later in the afternoon/evening. Two different time periods were used to catch a wider range of consumers, since it became clear that time of day correlated with the age of consumers passing by. To be effective the time of day were also taken into account to get a large enough number of respondents.

When approaching potential respondents a specific phrase was used “Hello, we are conducting a survey about food safety, would you like to answer some questions?”. This phrase was the one that worked best in the trial run. If they said yes, they were given a binder and the instructions that it contained a short description of the aim of the study followed by a front- and backside with questions followed with a sheet with the text “thank you for your participating. Have a nice day!”. The binder also contained the thresholds of radioactive substances set by the National Food Agency in Sweden, if some respondents would want more information.

All individuals passing by were approached to reduce the risk of the human factor in selecting who was approached. However when all binders were occupied that was not possible. Approximately every sixth person approached was willing to participate. The ones not willing to participate were not in the long-run possible to count and therefore this is just an approximation and also the reason an exact response rate cannot be measured.

4.2. Data description

In total 218 respondents were included in the final sample. Out of those, 14 respondents had missing values. Those with missing values were analysed to see if there could be a pattern so that the missing values were not random. However such a pattern could not be found when analysing the missing values. 110 responses were collected at ICA Kvantum Väsby and 108 at ICA Kvantum Arninge.

The distributions of the variables are presented in the table two. The sample contains of an equal share of males and females. The largest age group were those over 70 years old with a share of 22 percent, followed by the age between 50-59 years with a share of 19 percent. 69 percent of the respondents did not have children younger than 18 years of age. The most common size of the household was two members with a share of 39 percent. The most common level of education was secondary level with 39 percent, followed by college/technical training with a share of 21 percent.

Table 3 - Sociodemographic characteristics

Variable	Description	Outcome
Age	Age of respondent	19 years or younger: 5% (10 out of 217) 20-29 years: 14% (31 out of 217) 30-39 years: 11% (23 out of 217) 40-49 years: 12% (27 out of 217) 50-59 years: 19% (41 out of 217) 60-69 years: 17% (38 out of 217) 70 years or older: 22% (47 out of 217)
Gender	Gender of respondent	Female: 50% (109 out of 218) Male: 50% (109 out of 218)
Children	Children under 18 years of age	No children under 18 years: 69% (150 out of 218) Children under 18 years: 31% (68 out of 218)
Size of household	Number of members in the household	1 member: 18% (39 out of 218) 2 members: 39% (84 out of 218) 3 members: 12% (26 out of 218) 4 members: 22% (49 out of 218) 5 members: 7% (15 out of 218) 6 members: 2% (5 out of 218)
Education	Level of education	Primary level: 8% (17 out of 216) Secondary level: 39% (84 out of 216) College/technical level: 21% (45 out of 216) Bachelor degree: 17% (37 out of 216) Master degree: 13% (27 out of 216) Doctoral degree: 3% (6 out of 216)
Income	Level of household income per year	Less than SEK 200 000: 6% (12 out of 213) SEK 200 000-400 000: 33% (71 out of 213) SEK 400 000-600 000: 28% (60 out of 213) More than SEK 600 000: 32% (70 out of 213)

For the questions regarding knowledge and attitudes the distribution of the answers are presented in table three. The largest share of the respondents with 42 percent strongly agreed that they knew that radiation equipment at Forsmark nuclear power plant had detected and reported about the radiation from the accident in Chernobyl in 1986. The respondents also seemed to be aware of the share of electricity nuclear power in Sweden.

For the indicators about food information usage the respondents did not seem to use the recommendation set by the National Food Agency in Sweden. 39 percent strongly disagreed to the statement that they use the food recommendation set by the agency. However 76 percent answered that they at some degree, look for origin when buying food products.

As a way to check the sample against previous studies, the question about attitude towards nuclear power was designed in a similar manner. Around 50 percent answered that they agreed to some level that Sweden should abandon nuclear power in the long run.

Table 4 - Nuclear power knowledge and food information

Variable	Description	Outcome
Radiation_equipment	I know that radiation equipment at Forsmark nuclear power plant was first in western Europe to detect and report about the radiation from the accident at Chernobyl in 1986.	Strongly disagree: 20% (43 out of 218) Partly disagree: 5% (11 out of 218) Neither: 19% (41 out of 218) Partly agree: 14% (31 out of 218) Strongly agree: 42% (92 out of 218)
Phase_out_2010	I know that the Swedish parliament decided in 1980 that no new nuclear power plant would be built and existing would have been phased out in 2010.	Strongly disagree: 11% (24 out of 218) Partly disagree: 6% (12 out of 218) Neither: 17% (36 out of 218) Partly agree: 21% (45 out of 218) Strongly agree: 46% (101 out of 218)
10_active_reactors	I know that Sweden has 10 active nuclear power plants, generating approximately 40 % of Sweden's electricity.	Strongly disagree: 13% (29 out of 218) Partly disagree: 8% (17 out of 218) Neither: 28% (62 out of 218) Partly agree: 28% (61 out of 218) Strongly agree: 22% (49 out of 218)
Ringhals	I know that Ringhals 1 and Ringhals 2 will be phased out earlier than first planned, 2020 and 2019 respectively.	Strongly disagree: 16% (35 out of 214) Partly disagree: 7% (15 out of 214) Neither: 23% (49 out of 214) Partly agree: 27% (58 out of 214) Strongly agree: 27% (57 out of 214)
Longrun_phase_out	Sweden should in the long run abolish nuclear power.	Strongly disagree: 20% (43 out of 217) Partly disagree: 15% (32 out of 217) Neither: 15% (32 out of 217) Partly agree: 21% (45 out of 217) Strongly agree: 30% (65 out of 217)
Origin	I look for information about origin when I buy food products.	Strongly disagree: 11% (23 out of 218) Partly disagree: 7% (15 out of 218) Neither: 7% (15 out of 218) Partly agree: 43% (94 out of 218) Strongly agree: 33% (71 out of 218)
Concern	I am concerned about food that could contain radioactive substances.	Strongly disagree: 34% (75 out of 218) Partly disagree: 17% (37 out of 218) Neither: 17% (37 out of 218) Partly agree: 17% (38 out of 218) Strongly agree: 14% (31 out of 218)
Food_recommendation	I use the recommendations set by the National Food Agency in Sweden about food that contains radioactive substances.	Strongly disagree: 39% (84 out of 218) Partly disagree: 8% (17 out of 218) Neither: 25% (55 out of 218) Partly agree: 17% (36 out of 218) Strongly agree: 12% (26 out of 218)
Food_info_Chernobyl	I look for information regarding food safety for products that could contain radioactive substances from the accident in Chernobyl in 1986.	Strongly disagree: 42% (91 out of 218) Partly disagree: 17% (38 out of 218) Neither: 20% (43 out of 218) Partly agree: 13% (28 out of 218) Strongly agree: 8% (18 out of 218)
Food_info_Fukushima	I look for information regarding food safety for products that could contain radioactive substances from the accident in Fukushima in 2011.	Strongly disagree: 51% (111 out of 218) Partly agree: 15% (33 out of 218) Neither: 19% (42 out of 218) Partly agree:10% (22 out of 218) Strongly agree: 5% (10 out of 218)

The WTP was measured as a situation where the respondent was facing a potential purchasing situation with a given amount of the product at a given price and a couple of alternatives for the WTP.

In table four the distribution of the willingness to pay is presented. For WTP for potatoes the largest share, 49 respondents, answered a WTP of SEK 5 or more, closely followed by SEK 1-2 that 48 respondents answered. For minced beef the WTP alternative that got most responses were SEK 14 or more with 23 percent of the respondents, followed by SEK 4-7 with 19 percent of the respondents.

Table 5 - description of WTP for potatoes and minced beef

Variable	Outcome
WTP Potatoes	SEK 0: 13% (29 out of 216)
	SEK 1-2: 22% (48 out of 216)
	SEK 2-3: 16% (34 out of 216)
	SEK 3-4: 13% (28 out of 216)
	SEK 4-5: 13% (28 out of 216)
	SEK 5 or more: 23% (49 out of 216)
WTP Beef	SEK 0: 14% (31 out of 216)
	SEK 1-4: 15% (33 out of 216)
	SEK 4-7: 19% (42 out of 216)
	SEK 7-10: 15% (33 out of 216)
	SEK 10-14: 12% (27 out of 216)
	SEK 14 or more: 23% (50 out of 216)

A chi-square test was made to see if WTP for potatoes and WTP for minced beef were dependent on each other. The test gave a p-value of 1.83E-48, which means that they are dependent on a significance level of 99 percent.

Concluding remarks, data collection and description

Data was collected outside two supermarkets in the outskirts of Stockholm. In total, 218 responses were collected. The sample had quite high share of older respondents, an equal share of men and women, a higher share did not have children under 18 years of age, the most common household size was two members, 39 percent had secondary educational level as the highest and most had a yearly household income of more than SEK 400 000.

Knowledge of nuclear power events, policy decision and current production was in general high, or higher than not having knowledge. Many of the respondents seemed concerned for origin of their food products in general but connected to nuclear accidents and radioactive substances the concern seemed less. Most of the respondent reported a positive WTP for both food products.

Chapter 5 – Result

The perception of risk connected to radioactive substances in food products was tested in two separate models. The models were formed so that all potential variables were tested in model one and in model two some changes were made to improve the result. WTP will be presented in five separate models respectively for potatoes and minced beef. The models are expanded so that each model introduces a new subgroup of independent variables.

5.1. Perception of risk connected to nuclear substances in food products

Two models were used for testing risk perception, level of concern, as the dependent variable. One model including all possible variables, the other model was introduced to see if some variables in fact better could explain the outcome as interaction variables between gender and nuclear attitude, and gender and food recommendation. The result of both models are presented in table five. In the table the coefficients are estimated but should not be interpreted as they are, marginal effects will be presented in section 5.1.1 and section 5.1.2.

In model one, the significance of the explanatory variables are overall quite low. Where children, food_recommendation, food_info_Fukushim and the unknown parameters, μ_1, μ_2, μ_3, are the only ones that are significant on at least a 90 percent significance level.

Table 6 – Dependent variable, Concern

Variable	Model 1	Model 2
Constant	0.354379	0.22798
Sociodemographic characteristics		
Age	0.8E-02	0.01040**
Gender	0.19633	0.07742
Children	0.40742*	0.33149*
Income	-0.7E-06	-0.1e-05**
Household_size	-0.11214	-
Education	-0.07275	-0.05887
Knowledge and attitude		
Radiation_equipment	0.01654	-
Phase_out_2010	-0.04258	-
Ten_active_reactors	-0.11908	-0.09885
Ringhals	-0.10992	-0.12274*
Longrun_phase_out	0.04252	-0.07543
Food information		
Food_recommendation	0.26388***	0.39419***
Food_info_Chernobyl	0.06979	
Food_info_Fukushima	0.40175***	0.45806***
Origin	0.02150	-
Interaction terms		
Longrun_phase_out*gender	-	0.22795**
Food_recommendation*gender	-	-0.24319**
Threshold parameter		
μ_1	0.65917***	0.68019***
μ_2	1.26251***	1.30086***
μ_3	2.02423***	2.06286***
Number of observations	206	206
Scaled R^2	0.42513	0.44098
Schwarz B.I.C.	319.064	308.673
Log likelihood	-268.449	-266.050
LR (zero slopes)	104.481(0.000)	109.280 (0.000)

* Significant at 90%, ** Significant at 95%, *** significant at 99%

In the second model some variables were excluded while others were included. Model one gave a scaled R^2 of 0.425 and the corresponding number for model two is 0.441. Consequently model two did a better job in describing the variability in the dependent variable, taken into account also that less variables were included the scaled R^2 did not raise simply by adding additional variables. In addition the Schwarz B.I.C. value decreased with model two which also indicates that model two is a better model. For both models the LR-test of zero slopes can also be rejected, which means at least one coefficient of an independent variable is not zero.

When introducing model two, age turned significant to 95 percent significance level. Income and ringhals turned also significant on 95 percent and 90 percent significance level

respectively. In model two the variables food_recommendation and longrun_phase_out were allowed to work as interaction terms which seems to improve the result of the model, both were interacted with gender.

Contrary to the expectations, a number of the proposed explanatory variables in the subgroup of knowledge and information was not significant. In model one, no one of the knowledge variable were significant, in model two, ringhals turned significant. So only one out of four proposed showed an effect on concern. For the subgroup of food information variables, food_recommendation and food_info_Fukushima showed a significant impact in both models. Leading to two out of four proposed independent variables showing an significant impact.

5.1.1. Marginal effects for sociodemographic characteristics, knowledge and information

The marginal effects for model two are divided into subgroups of sociodemographic characteristics, knowledge and information. The marginal effects for the interaction terms are presented in section 5.1.2. For sociodemographic characteristics the marginal effects are presented in table seven. Including age, children, income and education. Gender will be presented in connection to the interaction terms.

Table 7 - marginal effects, sociodemographic characteristics

Concern	Age**	Children*	Income**	Education
Y=0 (Strongly disagree)	-0.00344	-0.07028	3.75E-07	0.01946
Y=1 (Partly disagree)	-0.00070	0.07090	7.64542E-08	0.00397
Y=2 (Neither)	0.00086	0.18716	-9.42006E-08	-0.00489
Y=3 (Partly agree)	0.00182	-0.04613	-1.98817E-07	-0.01033
Y=4 (Strongly agree)	0.00145	-0.14164	-1.58E-07	-0.00821

* Significant at 90% in model 2, ** significant at 95% in model 2.

The probability of strongly disagree decreases when age increases corresponding to a 0.3 percentage points change, partly disagree decreases by 0.07 percentage points, neither increases by 0.08 percentage points, partly agree increases by 0.18 percentage points and strongly agree increases by 0.15 percentage points. Overall when age increases the probability of ending up in one of the categories of being concern increases.

Having children decreases the probability of strongly disagree to having concern corresponding to 7.0 percentage points, partly disagree increases by 7.1 percentage points, neither increases with 18.7 percentage points, partly agree decreases by 4.6 percentage

points and strongly agree decreases by 14.2 percentage points. Having children highly increases the probability of neither being concerned or not concerned.

Income is significant, however the effect is quite small. A one-unit change in income changes the probability of strongly disagree to being concerned by 0.0000375 percentage points. When income increases one unit the probability of partly agree increases with 0.00000765 percentage points, decreases the probability of neither with 0.00000942 percentage points, partly agree with 0.0000199 percentage points and strongly agree decreases with 0.0000158 percentage points. When income increases the overall distribution of probabilities for concern moves towards the lower categories, meaning that income increases leads to lower levels of concern.

A one-unit change in education increases the probability of strongly disagree corresponding to 1.9 percentage points, partly disagree increases by 0.4 percentage points and neither, partly agree and strongly agree decreases with 0.5 percentage points, 1.0 percentage points and 0.8 percentage points respectively. However education showed no significance in the model.

In table eight the marginal effects are presented for nuclear power knowledge, represented by ten_active_reactors and ringhals, attitude and food information, represented by food_info_Fukushima.

Table 8 - marginal effects, knowledge and food information

Concern	Ten_active_reactors	Ringhals*	Food_info_Fukushima***
Y=0 (Strongly disagree)	0.03268	0.04058	-0.15143
Y=1 (Partly disagree)	0.00667	0.00828	-0.03090
Y=2 (Neither)	-0.00822	-0.01020	0.03808
Y=3 (Partly agree)	-0.01734	-0.02153	0.08036
Y=4 (Strongly agree)	-0.01379	-0.01712	0.06389

* Significant at 90% in model 2, *** significant at 99% in model 2.

A change in ten_active_reactors increases the probability of strongly disagree by 3.3 percentage points and partly disagree by 0.7 percentage points, it decreases the probability of belonging to neither, partly agree and strongly agree by 0.8 percentage points, 1.7 percentage points and 1.4 percentage points respectively. However ten_active_reactors were not a significant variable in the model.

A one-unit change in the variable ringhals corresponds to a probability change of 4.1 percentage points for strongly disagree, 0.8 percentage points for partly disagree, a decrease in probability of neither by 1.0 percentage points, 2.2 percentage points for partly agree and the probability for strongly agree decreases by 1.7 percentage points. When knowledge of a current policy decision increased the concerned moved towards the less concerned outcome categories.

A one-unit change in food_info_Fukushima decreases the probability for strongly disagree and partly disagree by 15 percentage points and 3.1 percentage points respectively, and a one-unit change increases the probability of belonging in neither with 3.8 percentage points, partly agree with 8 percentage points and strongly agree with 6 percentage points. When searching for food information connected to Fukushima increases the probability of being more concern seems to increase as well.

5.1.2. The gender issue

Gender was assumed to be a key variable to be able to estimate the effect of nuclear power attitude as an independent variable for level of concern. In addition food_recommendation was also assumed to have a correlation with gender and would also be better explained as an interaction term with gender. The marginal effects for these variables are presented in table eight.

Table 9 - Marginal effects, interaction terms

Concern	Longrun_phase_out (Man)	Longrun_phase_out (Woman)	Food_recommendation (Man)	Food_recommendation (Woman)
Y=0 (Strongly disagree)	-0.07488	0.02494	-0.07438	-0.13031
Y=1 (Partly disagree)	0.01861	0.00509	0.01871	-0.02659
Y=2 (Neither)	0.03549	-0.00627	0.03537	0.03277
Y=3 (Partly agree)	0.02410	-0.01323	0.02383	0.06916
Y=4 (Strongly agree)	-0.00332	-0.01052	-0.00353	0.05498

Attitude towards nuclear power, longrun_phase_out, has as shown in table eight different impacts on level of concern depending on gender. When longrun_phase_out increases one unit, being a man, the probability distribution becomes more narrow and the middle categories of concern increases. Where strongly disagree show the largest change in percentage point with 7.5 percentage points. Being a woman and increasing longrun_phase_out one unit the probability of being concern decreases. The effect from

longrun_phase_out seems to be bigger being a man since the redistribution of the probabilities are larger. As for men the largest change in percentage points is found in strongly disagree corresponding to 2.5 percentage points, however the effect is opposite, for men the probability of that outcome decreases whereas for women it increases.

The marginal effect for food_recommendation as an interaction term with gender show that being a woman, a change in food_recommendation has a larger impact on level of concern than being a man. The redistribution of the probabilities also show different patterns for men and women. For men when food_recommendation increases the probability of strongly agree and strongly disagree decreases and the middle categories increases. Whereas for women the two disagree categories decreases when food_recommendation increases and the other three categories increases. As for attitude, the largest percentage point change is found in strongly disagree for both men and women. But for food_recommendation, both changes are decreases in probability, corresponding to 7.4 percentage change for men and 13.0 percentage change for women.

5.2. WTP Potatoes

Several models were tested to find explanatory variables for willingness to pay for a label on potatoes ensuring that the level of radioactive substances is below the recommended. The result is found in table ten. From model one additional variables were included in an attempt to find the set of variables that best described the outcome.

Table 10, Result WTP Potatoes

Dependent variable – WTP Potatoes	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	1.94211*	1.40326	1.21452	0.99583	1.18479
Sociodemographic characteristics					
Age	0.15935***	0.14545***	0.13258***	0.14120***	0.15073***
Age^2	-0.00194***	-0.00177***	-0.00164***	-0.00175***	-0.00179***
Gender	-0.84736***	-0.69289***	-0.64661***	-0.61404**	-0.54035**
Children	0.52930	0.53435	0.49449	0.52765	0.39881
Income	0.13E-06	0.34E-06	0.26E-06	0.58E-06	0.93E-06
Household_size	-0.31962**	-0.29339**	-0.27054**	-0.30701**	-0.32601**
Education	-0.97819	-0.07173	-0.07650	-0.62699	-0.02163
Attitude					
Longrun_phase_out		0.18176**	0.16405*	0.13322	0.10494
Food information					
Origin			0.17112*	0.08052	0.10767
Food_recommendation				0.04905	0.12310
Food_info_Fukushima				0.17362	0.22349
Food_info_Chernobyl				0.83968	-0.02084
Knowledge					
Radiation_equipment					-0.09799
Phase_out_2010					-0.15789
Ten_active_reactors					-0.22094*
Ringhals					0.12025
R^2	0.23272	0.25028	0.26175	0.27842	0.29683
Adjusted R^2	0.20600	0.22014	0.22819	0.23402	0.23666
Number of observations	209	208	208	208	204

* Significant at 90%, ** Significant at 95%, *** significant at 99%

For WTP Potatoes model 5 described the largest amount of the variation in WTP, corresponding to 24 percent when using the adjusted R^2 and 30 percent when using the regular R^2.

The set of demographic variables showed a various degree of explanatory power. Age was significant throughout all models. The quadratic nature of the variable in combination with the signs of the age variables show that the affect of age on WTP is increasing up to a certain point and after that the effect decreases. The effect of age is shown in figure two. In figure two WTP is calculated at the mean of the other variables, at different ages. WTP seems to decrease somewhere around the age of 40 and 50 with the coefficients from model five. The sample did not contain too many minors so the age starts at 17.5 years of age in the figure. By computing the maximum point an age of approximately 42 years of age was found.

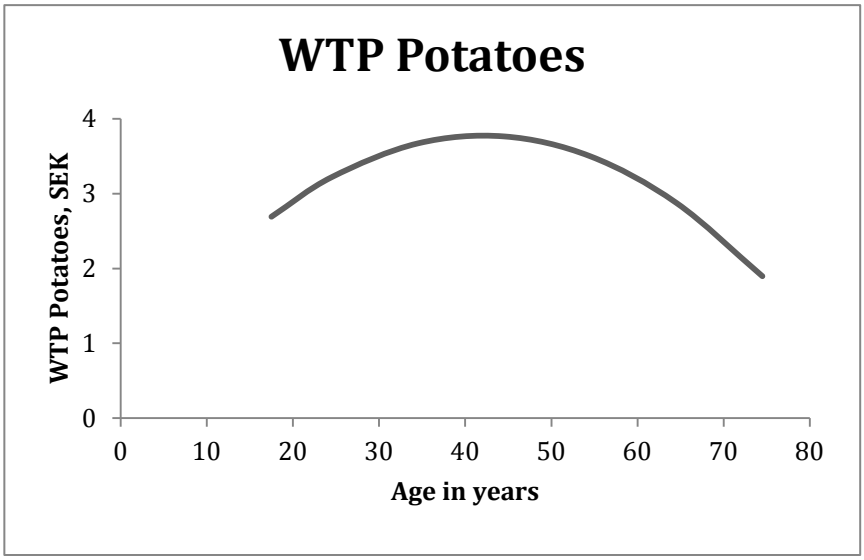


Figure 2 - WTP Potatoes, the age effect

Gender was also significant throughout the models. Gender had quite a large impact being a male decreased WTP for potatoes by SEK 0.54, in model five. The size of the household had a significant impact at 95 percent degree on WTP for potatoes in all models, with the highest effect in model five corresponding to a decrease in WTP at SEK 0.33 when size of household increased by one individual. Education, income and having children showed no significant effect in any of the models.

Attitude towards nuclear power showed significance in model two and three, but when including the food variables as well as nuclear power variables the coefficient turned insignificant. The coefficient showed a positive impact, when longrun_phase_out increases by one unit WTP increases with SEK 0.18 in model two and SEK 0.16 in model 3.

None of the variables concerning food showed significance in any of the models except origin, however it was only significant at 90 percent in the third model, increasing origin one unit increases WTP by SEK 0.17.

For the variables aiming to capture nuclear power and historic events only one variable showed significance at 90 percent. The variable of knowing the current production in Sweden, Ten_active_reactors, showed a negative correlation with WTP. Increasing the level of agreement to knowing the current production one step decreased the WTP with SEK 0.22.

5.3. WTP Beef

For WTP for beef the same approach was used as for potatoes. The model was expanded with variables in smaller sets according to the division in the questionnaire.

Table 11 - WTP Beef

Dependent variable – WTP Beef	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	2.64676	0.57639	-0.21485	0.21798	0.62004
Sociodemographic characteristics					
Age	0.50929***	0.45794***	0.40398***	0.40545***	0.40270***
Age^2	-0.00592***	-0.00527***	-0.00472***	-0.00476***	-0.00453***
Gender	-2.30500***	-1.73907**	-1.54504**	-1.53194**	-1.19843
Children	1.26815	1.2839	1.11678	1.15956	0.72793
Income	0.2588E-05	0.3410E-05	0.3082E-05	0.3337E-05	0.4433E-05*
Household_size	-0.86828**	-0.76465*	-0.66886	-0.69874***	-0.67179
Education	-0.47429	-0.37633	-0.39632	-0.38451	-0.24312
Attitude					
Longrun_phase_out		0.67851***	0.60426**	0.58428**	0.52196*
Food information					
Origin			0.71738**	0.66425**	0.73816**
Food_recommendation				-0.06699	0.12778
Food_info_Chernobyl				0.22775	0.4878
Food_info_Fukushima				-0.04133	-0.15772
Knowledge					
Radiation_equipment					-0.3092
Phase_out_2010					-0.24325
Ten_active_reactors					-0.77890**
Ringhals					0.16632
R^2	0.1983	0.22453	0.24705	0.24852	0.27386
Adjusted R^2	0.17037	0.19336	0.21283	0.20227	0.21173
Number of observations	209	208	208	208	204

* Significant at 90%, ** Significant at 95%, *** significant at 99%

Age and Age^2 were significant at 99 percent in all models with the largest estimated effect in model one. The impact of age on WTP from model five, to be able to make comparison to potatoes, is shown in figure three. WTP in figure three is calculated at the mean of the other variables at different ages. In the graph it can be seen that WTP starts to decrease somewhere 40 and 50 years. The maximum point is calculated at the age of 44 years.

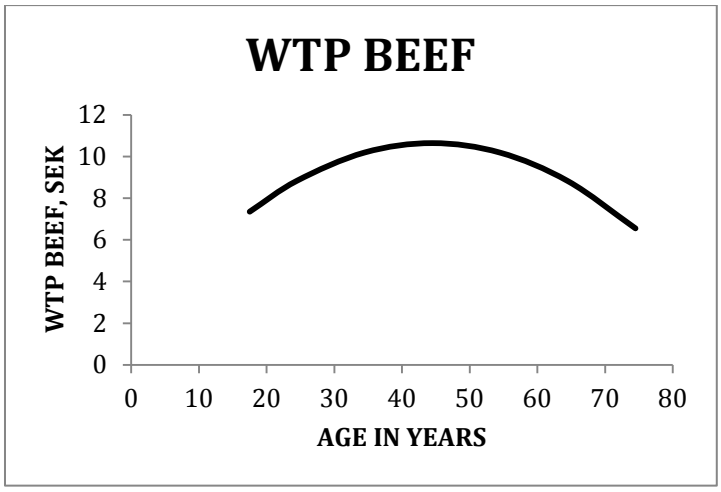


Figure 3 - WTP Beef, the age effect

Gender was significant in the first four models. The highest impact were estimated in the first model where the change in WTP by being a male corresponds to a decrease of SEK 2.3 in WTP at a 99 percent significance level. However in model five it turned insignificant.

Income was only significant at 90 percent in model five. However the estimated impact is very small, which might be because the size of the variable.

Size of household was significant in several models. All as a negative impact, when the household size increases the WTP decreases. The model with the highest adjusted R^2, model 3 the impact of a one-unit increase in size of household corresponds to a decrease of SEK 0.67, however in model 3, household size is not significant.

Education was insignificant throughout the models.

Attitude towards nuclear power seems to influence the WTP in all models. When it enters into the model the impact corresponds to an increase in WTP by SEK 0.68 when the attitude variable increases by one unit with significance at a level of 99 percent. Both the impact and the significance decrease when additional variables are included in the model. In model 5 the significance level is 90 percent and the impact corresponds to SEK 0.52 and model 3 with the highest adjusted R^2 a one-unit increase in longrun_phase_out corresponds to an increase in WTP by SEK 0.60. Wanting to phase out nuclear power seems to have a positive correlation with WTP to decreases the risk with radioactive substances in food.

Origin on food products in general seems also to influence the WTP for beef. All models that origin are included in the significance corresponds to 95 percent. The largest effect was found in model five with a positive relation to WTP, increasing the level of agreement to origin one step increases the WTP with SEK 0.74. In model three the corresponding number is SEK 0.72.

The remaining variables concerning food were insignificant as well as the variables aiming at capturing knowledge on nuclear power and nuclear history. Except for potatoes current production showed significance at a 95 percent level. The decrease in WTP by increasing the variable Ten_active_reactors one unit was SEK 0.78.

By comparing R^2 and adjusted R^2 the model that best explained the variation in the data set was according to R^2 model five and by adjusted R^2 model three. However the difference in adjusted R^2 is rather small. Where model five had a R^2 of 0.27 and an adjusted R^2 of 0.212, the corresponding number for model three were a R^2 0.25 and an adjusted R^2 0.213.

5.4. Variance inflation factor

Since several of the included variables could correlate, a Variance inflation factor test was made to make sure that the models did not suffer from multicollinearity. In table 12 the result from the variance inflation factor test are shown. The only variable with a value over five, which is an indicator on multicollinearity, is age and age^2. However this is neither a problem nor surprising since age^2 is a function of age and then it doesn't really qualify as mulitcollinearity.

Table 12 – Variance inflation factor

Variable	Variance inflation factor
Age	61.07
Age^2	61.77
Gender	1.24
Children	2.47
Income	1.71
Household_size	2.83
Education	1.17
Longrun_phase_out	1.33
Origin	1.37
Food_recommendation	1.52
Food_info_Chernobyl	3.00
Food_info_Fukushima	2.47
Radiation_equipment	1.89
Phase_out_2010	1.44
Ten_active_reactors	1.62
Ringhals	2.00

Chapter 6 - Discussion and concluding remarks

The discussion begins with general comments on the results, a more thorough separate discussion follows on the three dependent variables and the corresponding models. Last follows some overall comments on the data collection, some observations and lessons learned in the process.

The respondents in this survey did not seem overall concerned as shown by the distribution of their perception of risk. However, some factors seem to influence the perception of risk more than others. For example gender did played an important role as well as age, current production knowledge, income and attitude. The WTP for both potatoes and beef were quite high on average. Which might be strange given the rather low risk perception. This is somewhat unexpected since it can be anticipated that low risk perception is correlated to low WTP and vice versa. However a hypothetical bias might be present in this data set and will be further discussed later. Another possibility is how Rowe et al. (2000) described Sweden, as a "safety culture". That the population wants to be safe and therefore avoid risks more than others and therefore are willing to pay even though the risk perception is low.

How to increase the explanatory power might be something to take into consideration if a larger study regarding WTP would be conducted. However as mentioned in limitations, the questionnaire had to be kept rather short in this setup and for future studies it might be a good idea to reconsider the collection method and instead make sure that this rather complex subject is given enough space in a questionnaire and therefore another collection method, such as mail or e-mail, would be preferred.

Surprisingly, education did not seem to have an impact in any of the models presented in the result, neither risk perception nor WTP. As Yun et al. (2016) found education could lead to a decreased perception of risk and a lower WTP in connection to nuclear. The rather high share of respondents with high ages and low education in this study could explain this. A more representative sample might show another pattern.

Having children were not significant in the WTP models however it was significant in both the models of risk perception. The significance and effect in risk perception is in line with

the findings in Drottz-Sjöberg and Sjöberg (1990) with a negative impact on attitude if the respondent had children.

6.1. Risk perception

Two models were presented for risk perception. One where all possible variables were included and one more specified where both longrun_phase_out and food_recommendation was included as interaction terms with gender. When looking at the scaled R^2 this seemed to be an appropriate expansion of the model, raising the scaled R^2 from 42.5 percent to 44.1 percent. An explanatory power of 44.1 percent in model two should be seen as satisfying.

Education did not turn out to be significant in any of the models. This is a bit surprising since as for example Yun et al. (2016) found it could have an impact as mentioned before. This, however was not the case in this sample. Other variables without significance were ten_active_reactors, gender and longrun_phase_out. However both the last two should correlate with the interaction term since it is a combination of these two. Ten_active_reactors might be correlated with ringhals, and ringhals might capture a part of effect.

Age were significant in model two, with marginal effects showing the probability distribution moved slightly to the right, so that an increase in age increased the probability of ending up in a higher category, being more concerned about food contamination from nuclear substances. Having children was also significant in model two and having children under the age of 18 years made the probability distribution move so that more likely ending up in the middle categories compared to not having children. Income was significant in model two and an increase in income seemed to increase the probability of being less concerned. Income and education might be linked together, so that a higher education generates a higher income, however such a relation would have to be investigated further. Also as Grande (1999) found, individuals with higher household income do less to reduce risk.

Knowing current decision regarding nuclear power and its future in Sweden seemed to have a negative relation with concern, so that when knowledge increased the probability of being concerned decreased. This result is in line with Yun et al. (2016). Looking for food information regarding food products that could be produced in Japan where correlated with

being concerned, so when food_info_Fukushima increases the probability of not being concerned decreases and the probability of being concerned is increasing. It is interesting that the Fukushima accident seems to influence concern more than the Chernobyl accident. The Fukushima accident was more recent but the effect from Chernobyl was larger in Sweden and also the information given by the National Food Agency in Sweden, is largely more focused on the effects from Chernobyl. Yet the variable concerning Chernobyl did not turn out significant.

As Rosati and Saba (2004) found, perception of food risk could be explained by perceived personal risk and knowledge about potential food risk. A larger share of the food information variable should show to be significant in model 1 however, that connection could only be found in food_recommendation and food_info_Fukushima.

That gender should show an impact on concerned is quite in line with previous research such as Drottz-Sjöberg and Sjöberg (1990) and Grande (1999). The marginal effect for male and female for longrun_phase_out are almost the opposite of each other. When the extreme categories for concern for males decreases and the middle three increases, it is strongly disagree and partly disagree that increases for females while all other three decreases. For food_recommendation the marginal effect for males seems to follow the same pattern as for longrun_phase_out, the probability of the extreme categories decreases and the other ones increases. For women the two disagree categories looses probability and the other three increases. Strongly disagree to not using food_recommendation for women have a quite high marginal effect compared to the others, with 13 percent.

Gender did as the hypothesis stated play an important role in perception of risk for nuclear substances in food products. However a lot of the presumed social demographic explanatory variables did in fact not show to be significant for explaining concern which was not in line with the prediction.

So to summarize, the key independent variables for risk perception is age, having children, income, knowing a current policy event, searching for food information in connection to Fukushima, attitude interacted with gender and using food recommendation interacted with gender.

6.2. WTP Potatoes

Overall the explanatory power for WTP for potatoes would preferable be higher, as mentioned in the beginning of the result section. However, given the limitations for the questionnaire and the implementation, the number of variables had to be limited.

Age has up to an age of 42 years an increasing effect, after 42 years of age the effect starts to decrease. The effect of age on WTP for potatoes are has a similar effect in all models. Why age could be quadratic is that values and priorities might differ over a lifetime and WTP correspondingly differ. The respondents in the age where the effects start to diminish would have been teenagers at the time of the Chernobyl accident, an age where people in general are quite exposed to impressions. However the result is not in line with the findings in Grande (1999) where younger individuals do less do reduce risk.

Gender is also a significant variable, with a negative effect meaning that men are willing to pay less than women. If males in general have a more positive view (Holmberg, 2015) on nuclear power and lower risk perception (Drottz-Sjöberg, 1991) it seems reasonable that females report a higher WTP. This result is also in line with Grande (1999).

If people with children perceive a higher risk connected to nuclear power, those with children might also be willing to pay more to avoid danger, however this seems not to be the case since having children did show significance in any of the models. However this might be correlated with size of household, however it is not a case of multicollinearity, not according to the VIF preformed. Size of household on the other hand showed significance in all models. However this might not only indicate children since there was a share of single household. In model five the impact was a decrease in WTP by SEK 0.33 when the size of the household increased with one person. This finding is in line with Grande (1999), that larger household did less to avoid risk.

Income was not significant; an explanation could be the rather low initial price of potatoes. As Echeverría et al. (2014) points out, a product with low share in expenditure give small changes in demand. So individuals might be willing to increase their expenditure on potatoes without having to take income into account since the effect on the total food expenditure might not be that big anyway.

No one of the food information variables showed any significance. This is quite surprising since it seems possible that if you follow the recommendations you might not be as willing to pay for a label or maybe you would be willing to pay to escape the need to actively seek information elsewhere. The only variable on nuclear power knowledge that showed significance was ten_active_reactors.

Attitudes towards nuclear power and looking for origin for food products were only significant without the knowledge and food information indicators. In those cases the impact where positive, so being more in favour of phasing out nuclear power, increases the WTP. Increasing looking for origin when buying food products one-step increases the WTP by SEK 0.17, this could be explained by the findings by Westerlund and Lund (2006) that consumers preferring branded or organic food products are more concerned. An increase in a seeking origin for food products variable could be interpreted that you are willing to pay more for a label that ensures the level of nuclear substances to be low enough.

As the hypothesis stated, WTP for potatoes were presumed to be dependent on a set of three categories. However the variables in the set showed various degree of explanatory power, if any.

WTP Potatoes are determined by age, gender, size of household and knowing the current production of nuclear power.

6.3. WTP Beef

The overall explanatory power for WTP beef seems to be slightly less than for potatoes. In model three with the highest explanatory power according to the adjusted R^2 a few of the demographic variables showed no significance, including having children, income, size of household and education. As for potatoes, it is quite surprising that having children did not turn out significant, however the same situation might be present here, that the size of the household might capture at lest a part of the same effect. Since WTP might interfere with a household budget, it seems possible that income could have an impact on WTP. However, this seems not to be the case for beef except in model five where it is significant on a 90 percent significance level. It is also positive but quite small, however, taken into account that the variable initially is rather large, the effect is then interesting.

Attitude is significant, and in model three, with the highest adjusted R^2, a change in attitude one unit corresponds to a change in WTP by SEK 0.6 in the same direction all else equal. It seems reasonable that if you believe that nuclear power should be phased out you might also be willing to pay extra to avoid any harm from the same. It is quite interesting that attitude was significant throughout all variables with beef but not potatoes.

Origin was significant in all models for beef. Concern for overall origin for food products could explain a willingness to pay to avoid a food hazard, such as radioactive substances. However the rest of the food information variables did not show any significance in the models for beef.

In the subgroup of variables explaining knowledge connected to nuclear power, the only significant variable was knowing the current nuclear power production, ten_active_reactors. It could be argued that following the recommendations should lower your WTP since you already tries to avoid the potential risk, but that did not seem to be the case.

As the hypothesis states, beef are presumed to be dependent on the three set of variables. As for potatoes, these variables in the sets showed various degree of explanatory power for WTP for beef. As discussed above, some of the most surprising result is that income did not show any significance as well as that food information seemed not to be correlated with WTP.

WTP Beef are determined by age, income, nuclear attitude, searching for origin and knowing the current nuclear power production in model five. Which in contrast to WTP Potatoes was not the model with the highest explanatory power. However it is interesting to discuss the differences for potatoes and beef using the same set of variables.

6.4. General comments

When comparing the result between model five for WTP Potatoes and model five for WTP Beef a few of the findings are interesting to discuss. Gender was significant in all models for potatoes, for beef it was significant until model five was introduced. A potential explanation is some kind of bias for gender when additional variables were introduced, however it is interesting that it seemed not to be the case for potatoes. Income were significant for beef but not for potatoes. That could be explained by the budget share, where minced beef is

assumed to have a higher share than potatoes and therefore income plays an more important role for minced beef. Size of household are not significant for beef but it is significant for potatoes. Attitude towards nuclear power and searching origin were significant for beef but not for potatoes. However the actual monetary impact is less suitable for comparison due to the different monetary levels of the food products.

Further studies with an extended version of the questionnaire and a larger sample would be desirable. Possible extension for the questionnaire should include more question about food consumption habits of the respondents. It would be interesting to have a map on food products and ask which ones are most avoided, expand and look at several different food products. Another possible extension would be to have more in depth interviews with respondents to be able to better map their perceived risk, and be able to divide the perceived risk better into suitable subgroups. A larger sample would of course contribute to a more representative picture. Perception of benefits and disadvantages connected to nuclear power would also be interesting to go deeper into. A more representative sample would be recommended for future studies. One possibility is to use representative sample drawn from SPAR and send out the questionnaire by mail. Unfortunately, there is no such register with e-mails.

The environment in the situation where respondents got to answer the questionnaire could have affected the result. As Yu et al. (2014) describes it, outer stimuli might interfere with the respondents answers. The environment outside a supermarket might not be the best place and situation to ask these kinds of questions. However due to limitations a calmer environment for this survey was not possible.

The result might suffer from hypothetical bias. For future studies this has to be taken into account. As Carlsson et al. (2013) show, an oath script decreases the variance in WTP and decreases the extreme alternatives, the highest and lowest. Another possibility is to include a cheap talk script making the respondents aware that they are likely to overestimate their WTP. In this research an overestimated WTP could explain the difference between the rather low level of concern and the rather high WTP. Another possibility to get more accurate data, might be to include not only some kind of script but also a longer description of the situation today and present the recommendations before having the possibility to state WTP and level

of concern. However that could also interfere since that might influence respondents perception of the risk.

Some of the questions, besides WTP, might also touch upon respondents world view and self image. It could be the case that a respondent self image does not match the real situation such on knowledge level.

Some general comments on the implementation could be worth mentioning. It was easier to get respondents to participate if they saw someone else already participating. To get potential respondents to stop it was important to get the message through that it was a survey and not a company trying to sell. Younger individuals, especially females, were the hardest group to reach. This is something that should be remembered when analysing the result. However this group might not have a higher respond rate for another collection method such as mail or e-mail.

Some respondent said after their participation that it was an interesting topic but not something that they had thought of before. Some also wanted to discuss some of the questions and overall topics regarding energy policy, nuclear power and food safety which showed that participant thought it was an interesting subjects that they either knew much about, and wanted to discuss, or wanted to know more about.

6.5. Concluding remarks

This limited study of risk perception for food contamination from radioactive substances and WTP for a label ensuring the levels of radioactive substances to be below the recommended gave an indication for future studies. An indication that it is a topic that might need further research.

The purpose of this research was to find the determinants for level of concern regarding food contamination by radioactive substances and the WTP for potatoes and beef for a label ensuring the levels of radioactive substances to be below the recommended. It was done by preforming a survey outside two supermarkets where respondents got to state their level of agreement to a number of statements connected to nuclear power and food information. In addition they were asked to answer some sociodemographic questions.

The main findings were that level of concern was mainly determined by age, having children, income, knowing a current policy decision, seeking food information from products that might have been produced in areas affected by the Fukushima accident and two interaction terms, wanting to phase out nuclear power and gender, and using the food recommendation and gender. Gender seemed to have an important role as discussed for example in Drottz-Sjöberg and Sjöberg (1990). WTP for potatoes seemed to be explained by mainly age, in a quadratic setting, gender, size of household and knowing the current nuclear power production. WTP for minced beef was determined by age, also in quadratic form, income, searching for origin on food products, nuclear power attitude and knowing the current production of nuclear power.

The information on the current situation and the advice given from the National Food Agency in Sweden is easily found and also quite informative. The responses from the respondents in form of answers in the questionnaire as well as comments in the interaction gives an indication that the recommendations might not be known and used as they are intended to. Policy makers might want to increase the knowledge on finding good reliable sources to food recommendations overall. As for the public, an overall discussion on what to rely on and what is worth paying for and what knowledge is useful might be of value. The forum for this discussion is, however, not easily identified. It could be governmental agencies, media or related to companies in the food supply chain. Each with advantages and disadvantages.

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Appendix A

First follows a section with statements regarding energy and the environment. To what extent do you agree? Please choose ONE option per question.

	Strongly disagree	Partly disagree	Neither	Partly agree	Strongly agree
1-1: I think that the global warming is an important question.	☐	☐	☐	☐	☐
1-2: I know that radiation equipment at Forsmark nuclear power plant was first in western Europe to detect and report about the radiation from the accident at Chernobyl in 1986.	☐	☐	☐	☐	☐
1-3: I know that the Swedish parliament decided in 1980 that no new nuclear power plant would be built and existing would have been phased out in 2010.	☐	☐	☐	☐	☐
1-4: I know that Sweden has 10 active nuclear power plants, generating approximately 40 % of Sweden's electricity.	☐	☐	☐	☐	☐
1-5: Energy policy in Sweden has changed after the accident at Fukushima in 2011.	☐	☐	☐	☐	☐
1-6: I know that Ringhals 1 and Ringhals 2 will be phased out earlier than first planned, 2020 and 2019 respectively.	☐	☐	☐	☐	☐
1-7: Sweden should in the long run abolish nuclear power.	☐	☐	☐	☐	☐

Here follows some statements about food products. To what extent to you agree? Choose ONE option per statement.

2-1: I look for information about origin when I buy food products.	☐	☐	☐	☐	☐
2-2: I look for information regarding food safety for products that could contain radioactive substances from the accident in Chernobyl in 1986.	☐	☐	☐	☐	☐
2-3: I look for information regarding food safety for products that could contain radioactive substances from the accident in Fukushima in 1986.	☐	☐	☐	☐	☐
2-4: I am concerned about food that could contain radioactive substances.	☐	☐	☐	☐	☐
2-5: I use the recommendations set by the national food agency about food that contains radioactive substances.	☐	☐	☐	☐	☐

3-1: How much would you be willing to pay extra for 1 kilo potato with a label showing that the level of radioactive substances are below the limit set by the National food agency? Assume a price of 9,90 SEK/kilo.

0 kronor	1-2 kronor	2-3 kronor	3-4 kronor	4-5 kronor	More than 5 kronor
☐	☐	☐	☐	☐	☐

3-2: How much would you be willing to pay extra for 1 kilo minced beef with a label showing that the level of radioactive substances are below the limit set by the National food agency? Assume a price of 79,90 SEK/kilo.

0 kronor	1-4 kronor	4-7 kronor	7-10 kronor	10-14 kronor	More than 14 kronor
☐	☐	☐	☐	☐	☐

4-1: Which age category do you belong to?

☐ 19 years of younger
☐ 20-29 years
☐ 30-39 years
☐ 40-49 years
☐ 50-59 years
☐ 60-69 years
☐ 70 years or older

4-2: What is your gender?

☐ Female ☐ Male

4-3: Do you have children, 18 years or younger?

☐ Yes ☐ No

4-4: What is the size of your household?

☐ 1
☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7 or more

4-5: What is the highest level of education that you have completed?

☐ Primary level
☐ Secondary level
☐ College, technical training
☐ University, bachelor degree
☐ University, master degree (4 or 5 years)
☐ University, doctoral degree

4-6: Which of the following categories do you mainly belong to?

☐ Self-employed
☐ Student
☐ Long-term sick
☐ Employee in the public sector
☐ Retired
☐ Housewife / house husband
☐ Employee in the private sector
☐ Jobseeker
☐ Other

4-9: What is the size of your yearly household income?

☐ Less than SEK 200 000
☐ SEK 200 000-400 000
☐ SEK 400 000-600 000
☐ SEK More than 600 000

Här följer en rad påståenden om energi och miljö. I vilken grad instämmer du i dessa? Välj ETT alternativ per påstående.

	Instämmer inte alls	Instämmer delvis inte	Varken eller	Instämmer delvis	Instämmer helt
1.1: Jag anser att den globala uppvärmningen är en viktig fråga.	☐	☐	☐	☐	☐
1.2: Jag vet om att strålningsutrustning på Forsmarks kärnkraftverk var först i västra Europa med att upptäcka och rapportera om strålning efter olyckan i Tjernobyl 1986.	☐	☐	☐	☐	☐
1.3: Jag vet om att den svenska riksdagen bestämde 1980 att det inte skulle byggas några nya kärnkraftverk och att befintliga skulle ha avvecklats till 2010.	☐	☐	☐	☐	☐
1.4: Jag vet om att Sverige har 10 reaktorer igång som genererar ungefär 40 procent av elektriciteten.	☐	☐	☐	☐	☐
1.5: Svensk energipolitik har förändrats efter kärnkraftsolyckan i Fukushima 2011.	☐	☐	☐	☐	☐
1.6: Jag vet om att Ringhals 1 och Ringhals 2 ska avvecklas i förtid, 2020 respektive 2019.	☐	☐	☐	☐	☐
1.7: Sverige bör på lång sikt avveckla kärnkraften.	☐	☐	☐	☐	☐

Här följer en rad påståenden om livsmedel. I vilken grad instämmer du i dessa? Välj ETT alternativ per påstående.

	Instämmer inte alls	Instämmer delvis inte	Varken eller	Instämmer delvis	Instämmer helt
2.1: Jag söker information om ursprung när jag köper livsmedel.	☐	☐	☐	☐	☐
2.2: Jag söker information om livsmedelssäkerhet för matvaror som kan innehålla radioaktiva ämnen från olyckan i Tjernobyl 1986.	☐	☐	☐	☐	☐
2.3: Jag söker information om livsmedelssäkerhet för matvaror som kan innehålla radioaktiva ämnen från olyckan i Fukushima 2011.	☐	☐	☐	☐	☐
2.4: Jag är orolig för att mat kan innehålla radioaktiva ämnen.	☐	☐	☐	☐	☐
2.5: Jag använder Livsmedelsverkets rekommendationer om mat som innehåller radioaktiva ämnen.	☐	☐	☐	☐	☐

3.1: Hur mycket skulle du vara villig att betala extra för ett kilo potatis med en märkning som visar att värdet av radioaktiva ämnen är under gränsvärdet satt av Livsmedelsverket? Anta ett kilopris på 9,90 kronor.

0 kronor	1-2 kronor	2-3 kronor	3-4 kronor	4-5 kronor	Mer än 5 kronor
☐	☐	☐	☐	☐	☐

3.2: Hur mycket skulle du vara villig att betala extra för ett kilo nötfärs med en märkning som visar att värdet av radioaktiva ämnen är under gränsvärdet satt av Livsmedelsverket? Anta ett kilopris på 79,90 kronor.

0 kronor	1-4 kronor	4-7 kronor	7- 10 kronor	10-14 kronor	Mer än 14 kronor
☐	☐	☐	☐	☐	☐

4.1: Vilken åldersgrupp tillhör du?

☐ 19 år eller yngre
☐ 20-29 år
☐ 30-39 år
☐ 40-49 år
☐ 50-59 år
☐ 60-69 år
☐ 70 år eller äldre

4.2: Vilket kön tillhör du?

☐ Kvinna ☐ Man

4.3: Har du barn som är 18 år eller yngre?

☐ Ja ☐ Nej

4.4: Hur många personer består ditt hushåll av?

☐ 1
☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7 eller fler

4.5: Vilken är den högsta utbildningsnivå du har slutfört?

☐ Grundskola
☐ Gymnasium
☐ Högskola (2-årig utbildning) / Vidareutbildning
☐ Universitet, kandidatexamen
☐ Universitet, magister- eller masterexamen
☐ Universitet, doktorsexamen

4.6: Vilken av följande kategorier tillhör du <u>huvudsakligen</u>?

☐ Egenföretagare
☐ Student
☐ Långtidssjukskriven
☐ Offentliganställd
☐ Pensionär
☐ Hemmafru/man
☐ Privatanställd
☐ Arbetssökande
☐ Annan

4.7: Hur stor sammanlagd inkomst har ditt hushåll per år?

☐ Mindre än 200 000 kronor
☐ 200 000-400 000 kronor
☐ 400 000-600 000 kronor
☐ Mer än 600 000 kronor